SOCIAL AND ENVIRONMENTAL INFLUENCES ON THE USE OF TECHNOLOGY IN PUBLIC SPACES

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Abstract

This thesis is concerned with understanding and describing the factors that influence the use of technology in public spaces. Adoption and use of technological systems over the past few decades has grown considerably. With increased use the role of technology now pervades nearly every aspect of social interaction. Systems are now used more and more in public areas however it appears a somewhat ignored and little understood area of research within the human computer interaction (HCI) literature. Therefore new methods of assessment are required.

Investigating human interaction with technologies in public places provides a new way to conceptualise and study interaction and in particular relate findings to new technologies. Existing methods and guidelines related to the use of technology fail to consider socio-environmental factors. New methods of assessment should allow the examination of how socio-environmental and usability factors influence use of technology in public areas.

To assess how socio-environmental factors influence the use of technology in public spaces nine studies were undertaken using convergent methodologies. This has allowed a detailed examination and exploration of how socio-environmental factors influence the use. These investigations have led to the development of a questionnaire that is a valid, reliable psychometric tool and the Technology Acceptance Models for Public Space Technologies (TAMPS) that measures use of technology in public areas. Rather than focus purely on accessibility and usability factors this thesis has enabled the integration of those and socio-environmental influences.

The results suggest success in evaluating or facilitating adoption and use of ubiquitous and mobile devices acknowledging how social and environmental factors influence use is crucial. The HCI community, designers and service providers need to integrate findings from this thesis in future system design which will lead to technologies that are efficient, effective and satisfying to use.

In Memory of my Mam and Dad x

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Chapter 1

INTRODUCTION

The central argument in this thesis is that socio-environmental factors influence the use of technology in public places. The discussion highlights very little of the HCI or the psychological literature considers human interaction with technology in public areas. This chapter also demonstrates how HCI research has changed in relation to development in both the technology and its social use. This chapter sets the context for exploring these arguments. The chapter also outlines the aims, objectives and provides a review of the original contribution of this thesis.

1 Context of thesis

Adoption and use of technological systems over the past few decades has grown considerably. With increased use the role of technology now pervades nearly every aspect of social interaction. Systems are now used more and more in public areas however human interaction with technology in such places appears a somewhat ignored and little understood area of research within the human computer interaction (HCI) literature. Investigating human interaction with technologies in public places provides a new way to conceptualise and study interaction and in particular relate findings to new technologies. The challenge for this thesis is to fully understand the interaction between people and technology in public areas and find the factors that actually influence use.

Systems at one time were cumbersome, unpredictable, static and generally only used by people in the workplace. The introduction of the silicon chip began a dynamic change in how individual's used and interacted with technology. Systems began to be more powerful, smaller and used by people from all walks of life. Today humans interact with technological systems in a variety of different environments. The role of technology within social interaction is increasing as more and more people use a host of different devices for a multitude of different reasons (Myers 1996). Systems are used for activities related to our work, home, leisure, entertainment, travel and health (Damodaran 2001). People can be contacted or contact others, surf the web or find out the latest football score on their latest portable mobile device anytime, anywhere. Take a walk down your local high street and you will see numerous people using mobile telephones, personal digital assistants (PDAs) and automated teller machines (ATMs) to name but a few. Consider the following scenarios that highlight anywhere anytime access and use of both personal and public technologies:

> *'Jenny is meeting a friend in town when she suddenly realises she has forgotten what time they said they would meet. In the middle of a busy store she takes out her mobile telephone and contacts her friend to check the arrangements. Within seconds Jenny knows what time to meet and know doubt other people around also know her arrangements!'*

> *'Jenny also needs money and airtime added to her mobile phone. She knows she can do both tasks on an automated teller machine (ATM). She walks to the nearest ATM but has to wait in a small queue. Jenny waits patiently, even though the queue grows behind her. When it is her turn she approaches the ATM puts in her card and taps in her personal identification number (PIN). Jenny begins to feel somewhat nervous and tries to undertake both*

transactions as quickly as possible as she doesn't want others waiting to see how much she is withdrawing from the ATM and also she doesn't want to keep other people waiting. She completes both tasks successfully and goes off to meet her friend for lunch'.

The two scenarios outlined above suggest different interactions with different devices are somewhat constrained by time and place. In the case of Jenny and the use of her mobile telephone the scenario implies she gave no thought to other people listening to her conversation. However, if the telephone call had been more personal would she still have continued her conversation in a busy store? When Jenny used the ATM both tasks were completed successfully. However, the scenario also highlighted how Jenny felt uncomfortable due to a perceived lack of privacy and time pressure from other people waiting to use the device.

1.1 The challenge for HCI research

Hartson (1998) states that a core theme in HCI is to objectively design, construct and evaluate computer-based interactive systems. Technological systems need to be designed so people can use them efficiently, effectively, safely and with satisfaction. Yuan, Gretzel & Fesenmaier (2003) state effective technology use needs evaluation strategies that are able to capture and assess problems that go beyond the technology itself. They go on to discuss how research has now moved from system quality measures to user needs and assessment and more recently to social and situational models (e.g. Venkatesh & Davis 2000).

This thesis identifies and furthers our understanding of how socio-environmental factors influence the use of technology in public areas. It suggests factors such as privacy impact on use of both static systems such as automated teller machines (ATMs) and mobile systems such as telephones. Issues emerge that highlight how interaction in public areas is not straightforward but inter-relationships exist between several factors e.g. privacy and personal space. Implications for designers, developers, service providers and users are highlighted that show the importance of external variables on use.

1.2 The Past

In the past research focussed on man and machine and the interaction between the two. Early computer systems were primarily used to process data and information in the workplace (Damodaran 2001). Therefore, the interaction was seen as a one to one relationship between the user and the interface and ignored the needs, abilities and preferences of users (Carroll 1997). Early research used methods from cognitive psychology such as the information-processing model of human thought. This approach measured input, process, and output and ignored outside influences on use. Although people were using such systems in social settings and as part of their everyday activity, methods such as information processing looked upon users as isolated individuals pursuing solitary goals.

The growth in HCI began with the development of the personal computer (PC) in the 1980's. Users of systems were no longer trained or experts but from a variety of different backgrounds with different characteristics and therefore not homogeneous. The HCI community realised the importance of the whole interaction process and began research that took context into account. Users of systems were no longer considered isolated individuals pursuing solitary goals but interacting with devices in a social world that included other people. Researchers realised factors outside of the man-machine interaction had important influences on use and therefore needed to be analysed, if ignored would lead to inevitable flaws within systems.

In the 1980's methods were introduced such as user centred design in which usability was a primary goal of HCI research (Carroll 1997). Field studies were included in the user centred approach that considered the users real needs and circumstances (Whiteside & Wixon 1987). This new approach considered 'real situations and interactions' and argued against earlier laboratory based methods adopted from cognitive psychology. This method became to be known as contextual design. The aim of field studies was to uncover how users interacted with the technology in their normal context of use (Beyer & Holtzblatt 1997). The cognitive state of the user was considered less important than users' interactions with each other and with their external tools and media (Sharples et al 2002).

The development of systems used for communication in the 1990's led to an agenda in HCI research that began to consider the importance of social factors on system use (Carroll 1997). Hartson (1998) stated that during the development process the user interaction component must be given the same attention as the interface component to ensure usability in interactive systems. The HCI community acknowledged that design of systems should match the user's needs, preferences and therefore the end user needed to be considered early in the development process. The onus was on developing systems suitable for the intended activity the user wanted or needed to use them for, the underlying belief was that this in turn would lead to systems being efficient, effective and safe to interact with.

1.3 The Present

Technology is increasingly becoming important as a way of mediating communication and social interaction. Systems are developed that impact upon both our personal and professional lives. The advances made in technology have unchained the user from the desktop into interactions where access is anywhere, anytime. According to Jones (2002) everyone seeks to be connected in the everywhere, anytime and anyplace society. However, the type and location of systems can influence people's perception of use. As systems become more ubiquitous and free the user from time and place, research suggests that although anytime, anyplace may be possible it may not always be acceptable (Perry et al 2001).

Individual's behaviour in any social setting differs and is dependent upon whom or what they are interacting with. How to interact appropriately in any given situation is drawn from the actual environment, individual's expectations, cultural and social norms of behaviour. The use of communication technologies in everyday interaction highlights how context and communication change (Rasmussen 1997). For example, a conversation on a mobile telephone is generally between two people who do not share the same physical setting. Throughout the world mobile telephone use in public areas is a common phenomenon and generally the user gives very little consideration to others around at that particular time.

As society moves into an age when mobile technology is both powerful and pervasive and systems free the user from the constraints of time and place, it is therefore important to acknowledge that time and place directly affect the ways in which people will use these systems. Lash & Urry (1994) argued that new forms of social distance will have to be learnt in response to the changes in technological mobility.

At present, systems are still developed that fail to meet the users needs and this in turn results in great cost to the developer (Mahmood et al 2000). No one factor can be isolated as the cause of why certain systems fail as there exists a complex inter-relationship between several. Certain factors have been highlighted that have a major influence on adoption and use e.g. ease of use and usefulness (Davis 1989), user satisfaction (Gelderman 1998) and user attitude (Ditsa & MacGregor 1996).

To date there is sparse psychological or HCI literature on the interaction between people and technology in public places. Several factors are already known to influence the acceptance of technology (see Davis 1989) and environmental factors such as levels of privacy, social density are known to influence behaviour (Kaya & Erkip 1999, Gifford 1987, Sundstrom 1975). It is believed this thesis is the first to attempt to quantify the contribution these socio-environmental factors make to public technology use.

1.4 The Future

The future predicts computation embedded in our daily lives through the development of ubiquitous technologies. Petersen, Madsen & KjÆr (2002) suggest trends in development of technological systems are ones of product integration and complexity. For example, Charny (2003) argued makers of mobile telephones now cram the device with new features and ignore the social mayhem that follows. He discusses how some of these new features e.g. the ability to record conversations, are actually unlawful in the USA as both parties must be informed or give consent to do so.

The Utopian dream of the future is for technologies to be embedded within such artefacts as household appliances, buildings and clothing. Radio frequency ID tags (RFID) will be incorporated into nearly every item imaginable. These tiny devices send out radio signals picked up by Internet-linked computers. Devices to read the signals will also be implanted into artefacts in the environment, from walls to soft furnishings. When you walk into a room or store, everything you wear and carry will elicit a host of information about you (Rowan 2003). Privacy advocates have voiced concern over consumer fears related to tracking, advertising and control over personal information.

The vision of many service providers is to be able to deliver location specific advertising to wireless devices. Location aware services maybe considered convenient and increase perceived safety but reduce perceived levels of privacy as they are considered new surveillance techniques, the industry will not thrive unless individual's privacy is protected.

As advances are made and devices are increasingly used in public areas the challenge and obligation for the HCI community is to understand how people will interact with the introduction of new technologies. The social impact of such technologies is vast. If our understanding of factors that influence use is not fully developed users may perceive systems as threatening, intimidating, risky and difficult to use. Users may abandon systems due to lack of privacy and become less tolerant of them. For example, imagine sending a personal email on the latest public interactive wide-screen 60" television system in your local coffee shop, would you as a user feel at ease, have sufficient privacy and personal space to do so? Will the future see users relinquish their privacy for the pleasure and convenience of such ubiquitous technologies? When considering future systems context of use becomes more important due to the type of technology and the level of social interaction (Gasen 1996).

1.5 Types of technologies

Various technologies are used in public areas although those most commonly used are probably automatic teller machines (ATMs) and mobile telephones. Both systems are used with increasing frequency in a diverse range of environments, both are capable of delivering personal information in a timely and convenient manner, and both free the user – to a greater or lesser extent - from the constraints of time and place.

Devices used in public areas can either be classed as 'static' such as an ATM or 'mobile' such as a personal digital assistant (PDA) or mobile telephone. Although there exist several differences between static and mobile devices they still share commonalities. ATMs are considered a public resource in comparison to mobile telephones that are considered to be a personal artefact. Table 1.1 illustrates the different and similar uses of static and mobile devices.

	Static Systems		Mobile Systems	
	ATM	Information Kiosk	Telephone	PDA
Personal Device			☻	☻
Public Resource	☻	☻		
Receive Personal Information	☻	☻	☻	☻
Send personal Information		☻	☻	☻
Access financial details	☻	☻	☻	☻
Personalise			☻	☻

Table 1.1: Illustrates some of the different and similar uses of static and mobile devices.

1.5.1 Static systems – self-service technologies

The growth of new technologies is revolutionising the retail landscape, in particular self-service technologies (Meuter et al 2000). Self-service technologies (SSTs) range from ATMs to in-store information kiosks. SSTs also provide a wide variety and diverse range of services. For example, in the USA kiosks can be used to file for divorce rather than go through the traditional court system.

SSTs found in public areas such as ATMs and public information kiosks are generally used by people without any prior training or instruction. People walk up and begin to use systems whilst only giving minimal attention to any instructions on or around the device. However, what actually influences use of SSTs is very little understood.

When considering human interaction with systems in public areas consideration needs to be given to the user population, their characteristics, the actual environment and the location. Another important issue is the type of task or transaction the user will be using the system for. Many public systems require the user to enter personal and private information such as a personal identification number (PIN) needed to access financial information on an ATM.

Consumers are willing to use self-service technologies if they perceive them as convenient, efficient and comfortable. Bowen (1986) stated people use self- service technologies if they feel more in control. Feelings of control and enjoyment directly affect intention to use SSTs (Dabholkar 1996). Situational factors can have a strong influence on use e.g. crowding, if the user is alone or with friends. If in a hurry the waiting time to use the device will affect the users intention (Ledingham 1984).

1.5.1.1 The ATM

One of the most common computer interfaces people interact with in public zones is the Automated Teller Machine (ATM). De Angeli et al (2004) state it has taken 30 years to establish the ATM as a ubiquitous example of a public walk-up-and-use device. In the UK alone every day ATMs are used by more than a million people, withdrawing over £300 million. In 1983 Murdock & Franz reported some people's perception of using ATMs was one of embarrassment and degradation. The change in users' perceptions of ATMs over the past twenty years has changed dramatically. In fact today's western youth have not known a time when ATMs did not exist. Lacohee et al (2003) state ATM users expect three aspects of usage: fast, working and dispense cash. ATMs are considered a simple and intuitive process.

In the past ATMs have generally been located in 'holes in the wall' outside banks and supermarkets, however they can now be found in a multitude of different locations such as next to coffee kiosks, in garages and local stores. Although cash withdrawal is still the main reason for ATM use (70% of all transactions – Glover 2000), the location and the type of services ATMs provide are now on the increase.

The predictive factors for ATM use are already well documented and include system characteristics such as accessibility & location (Leblanc 1990). ATMs are also perceived as devices that are low risk (Moutinho & Brownlie 1989), fast and efficient (Leblanc 1990). Burgoyne, Lewis, Routh & Webley (1992) found the main advantages for ATM use were convenience, less queues compared to over the counter transactions and users could access their account 24 hours a day. The research by Burgoyne et al supported previous findings by Stanley & Moschis (1983) that reluctance to use new technology, in this case ATMs, was more common among older bank customers compared to younger ones. Burgoyne et al stated that customers' perceptions and attitudes towards ATMs determine their resistance to use. Rugimbana (1995) argued people's perceptions of ATMs are more powerful predictors of use than demographic variables. Zeithaml & Gilly (1987) found the major advantage of using ATMs was ease of use. Pepermans (1996) stated frequency of use was significantly related to people's attitude towards ATMs. Pepermans argued this finding supports the attitude-behaviour consistency link.

The services ATMs provide are now beginning to change. ATMs can now dispense a multitude of different things ranging from stamps to theatre tickets. A survey by Kulik (2002) into trends and future issues related to ATM use found that a favoured response was to be able to add airtime to mobile telephones at an ATM. This finding is consistent with the announcement that mobiles connected to the Orange network can now be 'topped up' at ATMs connected to Abbey National, UK and Euronet Worldwide networks.

In the USA, the 7-Eleven group have installed Vcom (virtual commerce) machines which are part ATM and part kiosk (Docherty 2002). These machines not only provide ATM services but a variety of other ones e.g. payment methods, e-shopping facilities. At one time surfing the net on an ATM seemed impractical but now users can. Vcom machines act as a portal and reduce browsing to a defined number of sites. The onus is on selling services around the concept of impulse buying. This keeps the transaction time brief and users can pay by cash over the Internet. The ability to pay by cash is considered to be a positive move that will encourage users who may not have a bank account or people who are reluctant to provide credit card details over the net.

1.5.2 Mobile Systems – the case of the mobile telephone

Mobile systems have not only revolutionised but also produced an alternate form of communication between people and changed how they interact within their social network. It is argued that mobile technologies offer an unprecedented means of connectivity, information and interaction with others (Katz & Aakhus 2002). The first mobile telephones were introduced in Japan in the 1970's. Although mobiles receive mainly positive evaluations, negative reactions have been towards safety (Harkin 2003), considered a digital leash for teenagers (Ling & Yittri 2002) and intrusive, particularly when face-to-face interaction is interrupted (Love & Perry 2004; Goodman 2003).

The mobile is now considered an instrument for both social and task based interaction (Ling & Yittri 1999). Although certain features of mobiles such as ringtones are often seen as obtrusive, the telephone itself is a useful commodity. Mobile telephone use in public places is a common phenomenon and generally the user gives very little consideration to others around at the time. However when used in public places the divide between public and private has become blurred. Ball (1968) suggested landline telephone users could be classed as social actors. He stated callers could utilise different tones of voice and background noise to portray what they wanted the listener to believe they were doing. Mobile telephone users are also classed as social actors as they know they are usually being watched and possible judged by others when they use their device in a public place (Johns 2001). Unwritten rules of social etiquette and interaction exist but often users of mobiles break these implicit rules which lead to problems with bystanders around at that time. Love & Perry (2004) suggested a simple set of normative rules for expected caller behaviour (the person using the telephone) and acceptable bystander behaviour. These rules related to callers assessing the situation, moderating the call length, conversational volume, content of the conversation, act with gratitude towards bystanders and make an effort to become 'apart' from bystanders as the setting allows. The rules for bystanders related to making the user aware of their presence by glancing at the caller and not paying attention to the content of the call. With the growing trend in adoption and use of mobile technologies the rules suggested by Love & Perry although not absolute emphasise the need to understand and document human interaction with technology in public places.

According to a report by Oftel (2002) three quarters of the UK population own a mobile phone. The past decade has seen an ever-growing number of studies into mobile telephone use (e.g. Ling & Yittri 2002). A number of factors are already known to affect mobile telephone use and these include ease of use and motivation

(Kwon & Chidambaram 2000), age (Brodie et al 2002), and gender (Ling 2001). It is also clear that different principles may affect speaking or text-messaging (Longmate & Baber 2002). Research by Love & Perry (2004) and Ling (1999) have both discussed problems that exist for bystanders when someone is engaged in a conversation on a mobile telephone. Ling's (1999) research highlighted how different locations such as restaurants are classed as inappropriate places for mobile telephone use. This is in line with railway companies having mobile free carriages. Use of certain mobile accessories e.g. cameras, are now banned from locations such as gyms and schools as service providers become more concerned over their clients' privacy. However, although there exists a vast amount of research into the effects mobile use have on bystanders, there exists very little research into factors that influence the actual mobile user. As advances are made in mobile and ubiquitous systems a fundamental issue for designers of such systems should surely be 'what are these influences and how do they affect use?'

1.5.3 Static and mobile integration

There is now a growing trend to integrate the functionality of static and mobile systems. For example, photographs taken on mobile devices can now be printed on the spot at do-it-yourself digital printing kiosks.

In countries like Finland and Japan mobile devices can be used to pay for soft drinks from vending machines. German based e-banking technology allows mobile users to pay for goods by taking a photograph of the barcode (Finextra.com 2004). The infrared capabilities (creates wireless link) of ATMs and mobile devices have also made it possible to undertake financial transactions between the two systems.

Transactions can be preloaded or keyed into a mobile device while standing at the ATM, the transactions are quickly executed and graphical information e.g. bank statements can be transmitted to the mobile device. The newest generation of ATMs will be able to communicate and synchronise data with mobile devices in many ways i.e. giving access to virtual cash (Poropudas 2003).

1.6 Aims and Objectives of Thesis

The aim of this thesis is to find the factors that influence the use of technology in public spaces from the user's perspective especially ATMs. This includes examining the ways humans interact, not only with technological systems used in public areas but also human –human interaction in such places. To this end the specific objectives of the thesis are to:

- Explore the interaction between people and technology in public areas
- Examine and categorise factors that influence use
- Demonstrate the effect that external factors and the influences other people have on use and the user of systems
- Understand how and to what extent external factors influence use
- Devise and demonstrate techniques, tools and methods for measuring such influences
- Relate the findings to the design and development of future systems

Dabholkar (1996) stated researchers are interested in how attitude towards technology may influence the extent to which consumers interact with technology-based services and products. Johnson & Coventry (2001) highlighted previous usability and applied psychological research into ATM use tended towards an analysis of the general usage and non-adoption aspects of consumers. This thesis integrates factors associated with technological adoption and environmental influences on behaviour. When trying to understand adoption and use in public areas many factors need to be taken into consideration.

1.7 Methodology

The methodology in this thesis had used a triangulation approach using observation, qualitative and quantitative techniques. According to Morse (1994) the use of triangulation methods provides a global view of a problem or area under investigation. The different techniques provide different insights through which to examine any emerging issues or problems. Data in this thesis is acquired by an exploratory study, participant observation, questionnaires, interviews, focus groups and experimental work. This approach has resulted in an in-depth coverage of the area ranging from exploratory investigative work to the testing of specific hypotheses. A detailed description of each method and an explanation of why that particular approach was used will be given in the relevant chapters.

1.8 Overview of thesis

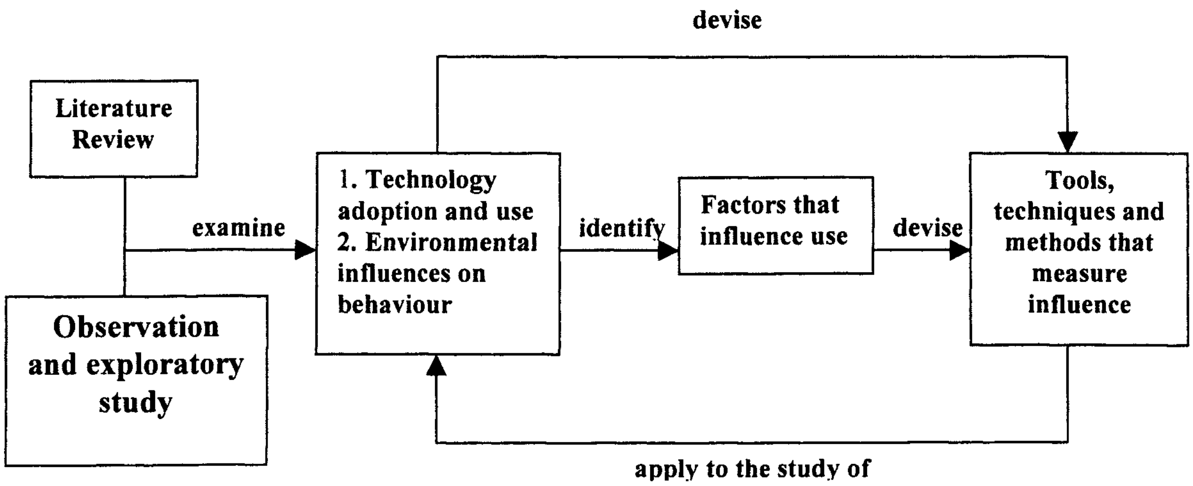

Figure 1.1 Overview of the thesis approach

Figure 1.1 provides an overview of the thesis approach. Following this introduction chapters 2 and 3 review the literature on technology adoption, attitudes and environmental influences on behaviour. These chapters integrate the HCI and psychological literature so that a clear explanation and limitations of both approaches are identified. Chapter 4 begins an exploratory investigation into factors that influence the use of technology in public places. Chapters 5 through to 9 apply the integrated approach through a number of studies that explore what factors influence the use and user of systems in public areas. In chapter 10 a review of the thesis is presented which highlights the importance of the results and discusses implications for future research.

1.9 Original contributions of this thesis

At present the majority of the HCI literature focuses on adoption and use of systems within the workplace or home personal use (e.g. Davis 1989; Kwon & Chidambaram 2000). Very little of the HCI or the psychological literature considers the interaction of people and technology in public areas. To date, the influence socio-environmental factors have on use of technology has neither been recognised nor explored.

The central argument of this thesis is that social and environmental factors have an important influence on adoption and use of technologies, in particular ATMs, when used in public places. If designers and service providers are to be successful in evaluating or facilitating adoption and use of ubiquitous and mobile devices then they need to acknowledge that social and environmental factors influence use. The HCI community need to acknowledge that existing methods and approaches need expanding to account for social and environmental influences with regard to technology use in public areas. Exploration of these key arguments has resulted in the thesis offering the following original contributions:

- Documentation and discussion of the socio-environmental factors that influence the use of technology in public places
- Development of a valid and reliable psychometric tool that measures these influences
- Demonstration of how this tool can be applied to various technologies
- Development and discussion of how existing HCI methods and approaches can be expanded successfully
- Development of a model that can be used to assess and measure the use of technology in public areas
- Justification that designers and service providers need to consider not only usability issues but their user population, their characteristics, the environment and the task the system will be used for
- Exploration of how context effects use

Chapter 2

Attitudes and Technology Acceptance

This chapter considers the importance of attitudes, attitude measurement and how they are implicated in technology adoption and use. Discussion focuses on the Technology Acceptance Model (TAM) proposed by Davis in 1989. It illustrates how TAM can be expanded successfully but there exists a need for the inclusion in the model of external variables that have a direct effect on attitude and intention to use a technological system.

2 Introduction

At present our understanding of human interaction with technological systems in public areas is limited. The future predicts technology embedded in our daily lives through the development of ubiquitous and ambient technologies. Individuals will be able to use a variety of systems to access information any time, any place. At the same time systems will surround us and information exchange between systems and humans will be pervasive. An important challenge for the HCI community is to understand current system use in public places to be able to design systems successfully for future use. There also exists a real need for the HCI community to develop theory and tools capable of assessing social influence on technology use in public places.

One major goal of this thesis is to develop a psychometric tool to measure factors that influence the use of technology in public places. Developing a reliable and valid questionnaire to measure those factors is important for the following reasons:

- To increase awareness and understanding of factors that influence use
- To determine and model the processes of how external variables influence system use
- Implications from the model will further help understand future system requirements

Previous research discussed in chapter one highlighted how an individual's attitude can influence adoption and use of a technological system. For decades social psychologists have studied the concept of attitudes and agree that attitudes are important, evaluative and serve a function. Therefore when considering human interaction with technology in public places user attitude towards a system is an important area that needs further investigation.

2.1 Attitude, intention and technology

An attitude can be defined as a psychological tendency expressed by evaluating a particular object or behaviour with some degree of favour or disfavour (Eagly & Chaiken 1993). Generally attitudes are formed about an object through experiences and exposure (Zajonc 1968). When formed through direct experience e.g. computer use, attitudes are classed as stronger, more accessible and relatively stable over time, resist persuasion and can predict behaviour (Azjen 2001, Eagly & Chaiken 1993, Petty & Krosnick 1995). Social norms and situational factors e.g. social pressures can conflict with a person's attitude and therefore have important implications on his or her behaviour. Attitudinal research highlights how a person's attitude towards an object influences his or her behaviour and is mediated by their behavioural intention to undertake that particular behaviour.

One model that incorporates attitudes and behavioural intention is the Technology Acceptance Model (TAM) proposed by Davis in 1989. TAM has been applied successfully to measure adoption and use of technological systems. Henderson & Divett (2003) state 'TAM is the most comprehensive attempt to articulate the core psychological aspects associated with technology use'. TAM is based on the Theory of reasoned Action (Fishbein & Ajzen 1975) described in detail later in this chapter. TAM implies there is a link between beliefs, attitudes, intentions and behaviour. The model is based on the impact of external factors on internal beliefs, attitudes and intentions. Major determinants in acceptance and use of a system are a person's behavioural intention (BI) and attitude towards the system. Attitude towards use is a function of two beliefs: perceived usefulness (PU) and perceived ease of use (PEOU).

TAM is relevant to research carried out in this thesis as the model considers both user attitude and intention to use a system. Also TAM has been successfully expanded to include external variables other than perceived ease of use and perceived usefulness proposed in the original model (see section 2.2 this chapter). As discussed in chapter one, one of the most common computer interfaces people use in public areas is the ATM. The location and services ATMs provide are now on the increase. As systems are under continuous development and change the ATM is an important public space technology and investigating factors that influence their use is essential. Pepermans (1996) argued frequency of use supports the attitude-behaviour consistency link. Therefore investigating use from the users' perspective is important. Research in this thesis incorporates the measurement of attitudes towards technology use in public places through frameworks such as TAM.

2.1.1 Attitude Measurement

Attitude measurement helps our understanding of how people perceive, interpret and interact with an object. Therefore measuring individuals' attitudes towards an object or objects can increase our understanding and if needed improve upon the interaction. As attitudes are not directly observable they can only be interpreted from external cues. Attitudes towards an object can be inferred from an individual's behaviour (verbal or non-verbal), context characteristics, the attribute of attitudes in its evaluation (Ajzen 1988). The most direct and simplest way to find out what an individual's attitude is towards an object is to ask them. In attitudinal research direct measures are the most commonly used method. Physiological responses can also be used to directly measure attitude towards an object through the use of galvanic skin response (GSR) and heart rate. However physiological measures only account for affective responses and not evaluative ones, therefore they are classed as unsuitable for complete attitude assessment (Bohner & Wänke 2002). Although indirect measures can be used they tend to be purely behavioural based and suffer from low construct validity. Indirect measures include observation of behaviour and response towards the object. Response is generally measured by speed and/or frequency; the time taken to respond (response latency) is said be a measure of attitude strength (Olsen 1999).

Surveys are the most commonly used method to measure attitudes. Surveys consist of a set of questions or statements that creates a structured way of asking individuals their attitude or attitudes about an object or objects. The aim is to obtain an unbiased and accurate assessment of the object. Generally surveys include several constructs the research team believe influence behaviour or use of the object. Ajzen (2002) states scales need to exist of multi-items, as they are a more reliable and direct measure of an attitude than single item responses. Generally in attitude surveys several statements are reverse scored to control for biased response by the participant. Also questions in the survey tend to correspond to the two components of attitude: cognition and affect. Statements or questions in surveys need to be carefully structured and worded, it is crucial in attitudinal research that the measure is actually measuring the attitude and not something else. Reliability of any survey or procedure is the extent the test yields the same results on repeated trials. Internal consistency refers to the extent a survey, procedure or grouped items being measured actually assess the same characteristic under investigation.

As attitudes are classed as evaluative responses e.g. either like/dislike they are generally defined by their direction and extremity that can be either positive or negative measures. Most attitude research asks individuals to respond by expressing their attitude towards a behaviour or object on a bipolar scale. Although several measurement scales exist two that are used most in attitudinal surveys are the Semantic Differential (Osgood et al 1957) and the Likert Scale (Likert 1932). These two scales have been found to have high internal consistency (Bohner & Wänke 2002).

The Semantic Differential Scale is the most commonly used type of multi-item measure. A statement or reference is made to the object of interest and participants respond using a scale that includes bipolar adjectives usually divided into seven response categories. Osgood et al found three underlying dimensions or factors associated with the participant's attitude towards the object: evaluation (good/bad), potency (strong/weak) and activity (fast/slow). The evaluation dimension usually explains the largest proportion of variance.

The Likert Scale (Likert 1932) consists of either a 5 or 7-point bipolar response scale. An individual's attitude towards an object or statement is measured using the 5 or 7 response categories that generally range from 1 strongly disagree to 7 strongly agree. Statements are categorised by beliefs, affect and/or behaviour towards the object. For example, a survey that wants to evaluate attitudes towards ice cream may ask individuals to respond using a 5-point scale to statements that include all several attitude components i.e. I *believe* ice cream is cold (belief), I *like* ice cream (affect) and I *eat* ice cream (behaviour). Also statements would be included that measure behavioural intention towards the object e.g. I intend to eat ice cream today. This procedure also accounts for the belief-attitude-intention link discussed later. To find whether an individual's attitude towards ice cream is positive or negative a score would be found by calculating the mean response across all items. By using the mean across items this provides evidence the strength or intensity of an individuals attitude. The different attitude components can also be measured separately. This takes into account an individual may have a strong belief about an object although his or her behavioural response may be opposite. This is often classed as attitude ambivalence which can lead to problems in attitude research.

2.1.2 Problems with measuring attitudes

Certain problems exist in attitude research such as 'attitude ambivalence' which is part of the cognitive component and refers to the fact that an attitude, for example towards an artefact, can be positive and negative, this reduces accessibility, stability, affects behaviour and judgement (Olsen 1999, Ajzen 2001). Ambivalent attitudes can arise through conflict between the affective and cognitive components (Eagly & Chaiken 1993). Ajzen (2001) suggested that ambivalent attitudes may be weak, indifferent or uncertain ones. However, attitude ambivalence may be influenced by several factors such as context.

Attitudinal surveys can suffer from strong contextual effects and people may interpret the question in the context created by previous questions (Ajzen 2001). Two criteria for good attitude measurement is the avoidance of systematic and random error. Systematic error in a survey can arise due to a participant's actual response not reflecting his or her true underlying attitude; they adjust their attitude to conform to social norms or social desirability (DeMaio 1984). Socially sensitive surveys may suffer more from systematic error than general surveys. Random error can occur due to participants misinterpreting or misreading the actual statements. Although random error increases the variability between scores it does not affect central tendency therefore tends to cancel itself out during analysis. Attitude surveys are said to be reliable measures if they are free from random error and high in construct validity therefore free from both types of error. Reliability of surveys can be measured in several ways: test – retest, split-half reliability and Cronbach alpha. To check for validity reliability needs to be first established. Convergent and discriminant measures can be used to check the validity of a survey. Generally scales or surveys consist of statements that relate to several constructs about an object. Convergent validity proves items on a scale are correlated therefore they are measuring what they purport to measure i.e. the scale is measuring the same attitude when the constructs are grouped into their respective category. Discriminant validity proves items on a scale are uncorrelated therefore they are measuring different constructs.

Using attitudinal surveys in research if devised carefully can yield reliable and valid data that furthers our understanding of why and how individuals react to or use an object. So far the discussion has highlighted the importance and validity of attitudes and how they can be used successfully in research. The use of attitudinal surveys as a predictive and explanatory tool has raised concern. Arguments have arisen, particularly in the field of HCI, that what people say they do and what they actually do are not the same. However, prior to undertaking a survey if attention is focussed on the object or behaviour under study and surveys are carefully designed, the measurement of attitudes becomes a reliable and valid measure. Findings can show how and why people respond to objects and what influences their use. Several theories have emerged in social psychology and expanded into the HCI field that have been empirically validated as good, reliable, valid measures and predictive of future behaviour. One theory that has been widely used and expanded is the Theory of Reasoned Action (Fishbein & Azjen 1975). The theory posits the link between belief-attitude-intention towards an object or behaviour.

2.1.3 Theory of Reasoned Action

One model that is widely used in social psychology to measure attitudes is the Theory of Reasoned Action (TRA) (Fishbein & Ajzen 1975). As stated earlier the model assumes there is a link between beliefs, attitudes, intentions and behaviour. Attitudes towards an object play an important role in influencing subsequent behaviour. Generally people act in a consistent reasoned way and work out the consequences of their actions and decide whether of not to perform a task on that basis (Ajzen 1988). The theory suggests the best predictor of how someone will behave is their behavioural intention (BI) to perform the behaviour, which in turn is determined by their attitude towards the behaviour or object and the subjective norm. As discussed earlier attitudes are based on beliefs and can either be positive or negative towards an object. The subjective norm is an individual's perception of what other people will think about his or her behaviour, therefore this explains why attitude and behaviour may not always be the same. Olsen (1999) agrees that different situations can influence both attitude and the subject norm therefore behaviour cannot always be predicted. When attitudes towards an object or behaviour become more action-orientated they are perceived as more important than the subjective norm. Action-orientated behaviours increase the formation of intentions to undertake the behaviour in question. When attitudes towards an object or behaviour are considered to be more state orientated the subjective norm influences the formation of intentions (Olsen 1999). A schematic representation of the Theory of Reasoned Action is depicted in Figure 2.1

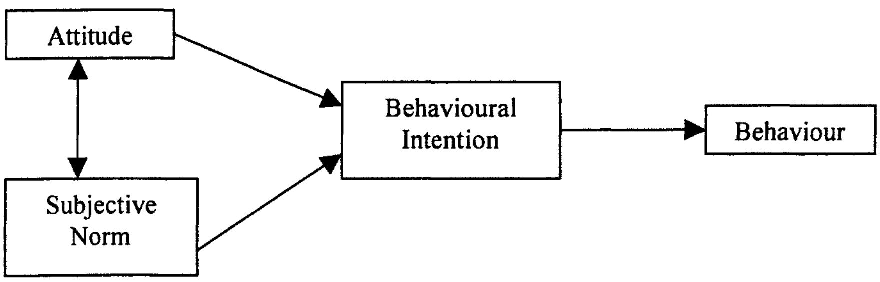

Figure 2.1 Theory of Reasoned Action (Fishbein & Ajzen 1975)

Fishbein & Ajzen acknowledged that certain variables not included in the model such as demographic and personality traits could also influence intention and behaviour but only if they influenced attitude and the subjective norm. They postulated that three conditions exist where intention can accurately predict behaviour:

- Intention and behaviour measures correspond in specificity of action, target, context and time frame.
- Intention and behaviour do not change in interval between assessment of intention and assessment of behaviour.
- The behaviour is under the individual's volitional control.

If all three conditions are not met then TRA becomes a poor predictor of intention to undertake a certain behaviour (Olsen 1999).

Several limitations of the theory have been discussed. Norman & Smith (1995) state that past behaviour is a key predictor of future behaviour and therefore this is an important issue for the theory that needs consideration. Trafimow & Finlay (2002) state the underlying assumption in TRA is that people are logical and this may be wrong. Behavioural expectations have been suggested as better predictors of behaviour than intention as expectations consider the probability of successful completion of the action (Warsaw & Davis 1985; Gordon 1989). Bagozzi & Yi (1989) argued that behavioural intention is only a good predictor of behaviour if the intention is well formed if not attitude is the best predictor.

2.1.4 Theory of Planned Behaviour

The Theory of Planned Behaviour – TPB (Ajzen 1988) expanded the TRA theory by adding perceived behavioural control (PCB). PCB is how easy or how difficult the behaviour is to perform which effects BI. PCB also includes the fact that in certain circumstances, influences or constraints on behaviour may exist that are beyond a person's control that has a direct effect on BI. A schematic representation of the Theory of Planned Behaviour is depicted in Figure 2.2.

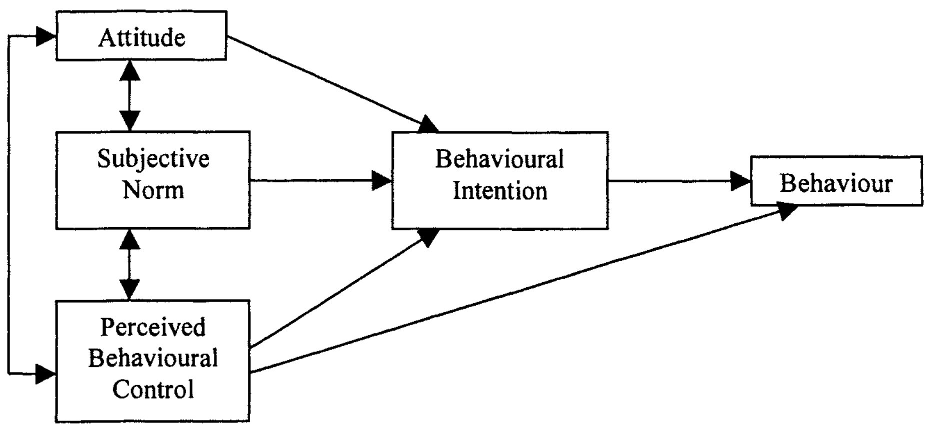

Figure 2.2 Theory of Planned Behaviour (Ajzen 1988)

TPB also considers the effect novel and/or unfamiliar events have on subsequent behaviour. People evoke careful deliberation and controlled construction of beliefs, attitudes and intentions when confronted with a novel or unfamiliar circumstance; this caution helps guide subsequent behaviour.

Oueltte & Wood (1998) carried out a meta-analysis of 64 studies that used the TPB. They found robust evidence that a major problem with the theory is that it does not consider past behaviour. As discussed earlier this problem is also evident in the Theory of Reasoned Action. The frequency of past behaviour was found to impact on both intention to carry out a task and subsequent future behaviour. Perugini &

Bagozzi (2001) argue that frequency of past behaviour only predicts future and not intention to undertake the behaviour. In response, Ajzen (2001) stated past behaviours predict future behaviours if factors remain stable such as context. Two processes proposed that indicate why past behaviour is important in the formation of intentions and in predicting future behaviour are:

- When the behaviour has become habitual
- When the behaviour was originally performed in an unstable context or environment or if the behaviour was not well learned.

In social psychology TRA and TPB have been empirically validated and used extensively for predicting or explaining behaviour using the belief-attitude-intention-behaviour relationship (Shih 2003). However when applying either theory, success in predicting behaviour or behavioural intention may be dependent upon the context and aim of the research. Several additional components suggested to improve the theories are: personal and moral norms (Gorsuch & Ortberg 1983), anticipated regret (Richard, van der Pligt & de Vries 1995), environmental influences (Kippax & Crawford 1993), desire to maintain a behavioural goal (Perugini & Bagozzi 2001), self-identity (Sparks & Guthrie 1998) motivation and opportunity (Fazio 1990) and affect (Manstead & Parker 1995). Therefore there does appear a need for additional components to TRA and TPB that reflect the area of research under investigation.

2.2 Technology Acceptance Model revisited

As discussed in section 2.1 TAM proposed by Davis in 1989 addresses certain system characteristics associated with adoption and use of technological systems. Similar to the TRA, TAM implies there is a link between beliefs, attitudes, intentions and behaviour. The model is based on the impact of external factors on internal beliefs, attitudes and intentions. Major determinants in acceptance and use of a system are a person's behavioural intention (BI) and attitude towards the system. Attitude towards use is a function of two beliefs: perceived usefulness (PU) and perceived ease of use (PEOU). Davis (1989) classified PU as 'the degree to which a person believes that using a particular system would enhance his or her job performance' (p.320) PEOU is classified as 'the degree to which a person believes that using a particular system would be free from effort' (p.320). PU is postulated as the major factor within the model accounting for over 50% of the total variance in the original research and PEOU as a secondary factor in determining system use. PEOU has an indirect effect through attitude on system use. PEOU also acts as a mediator through PU. PU is postulated as having the strongest direct effect on BI. TAM assumes the following positive direct or indirect influences on intention to use a system:

- Direct effect of PU
- Direct effect of PU on attitude
- PU and attitude collectively
- Direct effect of attitude
- Indirect effect of PEOU through attitude
- Indirect effect of PEOU on PU

Davis found a strong correlation between PU and use, he inferred if PU is controlled PEOU does not have an affect on system usage. Frequency and familiarity with a system decreases any influence from PEOU over time however this is dependent upon the complexity of the system. A schematic representation of the Technology Acceptance Model is depicted in Figure 2.3.

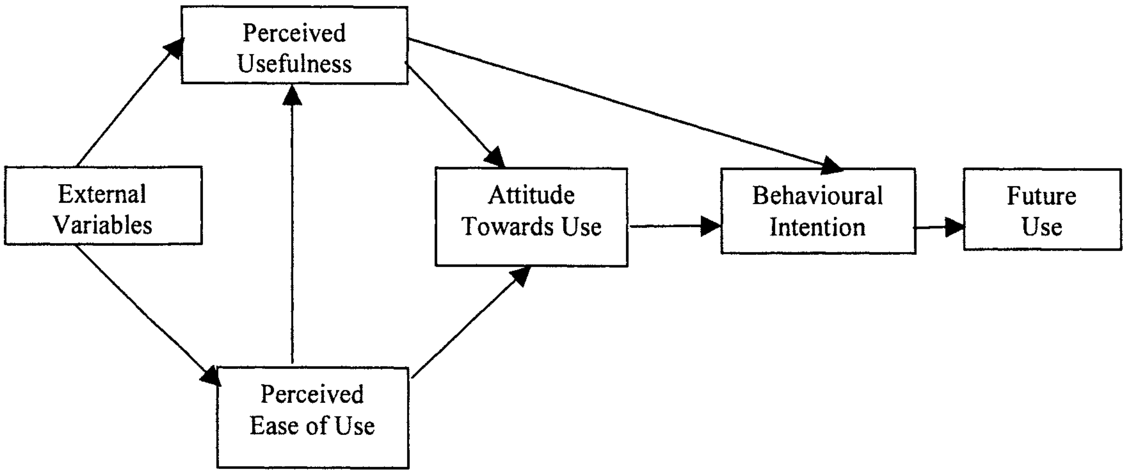

Figure 2.3 Technology Acceptance Model (Davis 1989).

Davis postulated extrinsic motivation drives use of a system by an individual's concern over performance, gain and associated rewards. Intrinsic motivation is only connected to the fun side of using a system and not just because they are extrinsically rewarded for doing so (Malone 1981). The affective component of attitude towards a system is determined by extrinsic and intrinsic motivation. Any increase in the affective component is associated with an increase in use (Davis 1993). Davis, Bagozzi & Warshaw (1989) found the influence of attitude on intention to use a system was minimal and therefore dropped the attitude construct from the model. PU and PEOU were considered the best predictors that had a direct effect on intention to use a system. PU was still postulated as the strongest predictor of intention. Davis et al hypothesised that although an individual's attitude maybe positive towards a system e.g. useful (belief) he or she may not like the system (affect). Therefore mixed or ambivalent attitudes cause problems when trying to predict use. Hence the omission of attitude helped better understand the influence of PU and PEOU on intention, the main dependent variable of interest (see Davis 1993, Thompson, Higgins, & Howell 1991).

Yang & Yoo (2003) argue the way in which Davis and colleagues measured attitude is the reason for finding a minimal influence from this construct. They suggest that both affective and cognitive components of attitude need to be measured separately. With regard to TAM no separate analysis was undertaken between the affective and cognitive components. Yang & Yoo argue this is why attitude was not found to be a significant predictor of system use in TAM. They postulate the significant influence of the cognitive component counterbalanced the non-significant influence of the affective component. Therefore the cognitive component of attitude can predict use more than the affective component as it mediates between PU and PEOU. The affective component may influence user satisfaction more than the cognitive counterpart (Yang & Yoo 2003). Several studies argue a separate analysis should be undertaken in attitudinal research of the affect and cognitive components (Petty et al 1998; Triandis 1980; Goodhue 1998; Swanson 1982) Proposals have been made that affective and cognitive components of attitude are two separate independent variables that effect BI (Goodhue 1998). Evaluation of systems may differ dependent upon what component is measured. For example, an individual may believe a system used at work is beneficial and more productive but not like the system due to preference for another one. Imagine the company this individual works for want to assess the system to see if it is more productive than an older system. They ask this individual to respond to various questions related to the system e.g. I believe the system increases my productivity; I like this system. The overall mean score for this individual attitude towards the system would be average. Hence the company may conclude that the system is mediocre and not worth investing in further. Interestingly, if systems are personal it may be the affective component is a better predictor of use compared to the cognitive component. Yang & Yoo also suggest that attitudes merit careful consideration in information systems research, not only to improve TAM but also the potentially powerful influence on implementation and diffusion of systems.

The previous discussion highlighted how measuring the different components of attitude separately can improve TAM. However, there already exists a large volume of past research into system use that maintained the attitude construct used in the original TAM (see Davis 1989; Malhortra & Galletta 1999; Chen, Gillenson & Sherrell 2002). These research examples still found attitude to play a major role in adoption and use of systems even though the two components were not analysed separately. TAM has been applied to assess adoption and use of various software packages and various types of technologies. However, results from studies that have used TAM tend to be varied. As already mentioned some research supports the original TAM (e.g. Davis 1993), compared to others that do not use the attitude construct and have found a direct effect on intention or use from PU and PEOU (e.g. Seyal, Rahman & Rahim 2003). Other research argues PU is not always the strongest predictor of intention or system use (e.g. Geffen & Straub 2000). Numerous other studies stress the need for an expanded TAM that incorporates the direct effect on attitude, intention and use from other external variables (e.g. Lucas & Spitler 1999).

2.2.1 In support of the original TAM

A number of studies fully support the original TAM (e.g. Davis 1993; Adams, Nelson & Todd 1992; Hu, Cha, Sheng & Tam 1999; Subramanian 1994). Hu, Cha, Sheng &

Tam (1999) applied TAM to measure adoption and use by physicians of a telemedicine software program. Their findings supported the original TAM although no link was found between PEOU and attitude. Subramanian (1994) used TAM to investigate adoption and use of a voice mail system. The findings from this study again validated TAM in that perceived usefulness was a greater predictor of system use than perceived ease of use.

2.2.2 In support of PU and exclusion of attitude

Mahmood, Burn, Gemoets & Jacquez (2000) carried out a meta-analysis of user satisfaction studies that had used TAM. They found the strongest predictor of system use was perceived usefulness and also the easier a system was to use the more likely people would use it. Although these findings support TAM, Mahmood et al did suggest past experience and skill strongly affect end use therefore need to be considered. Taylor & Todd (1995) investigated student adoption and use of a university computing system. They found no support for the attitude-intention link.

2.2.3 Considering other variables and weakness of PU

Some studies support TAM but emphasise a need to incorporate other variables that mediate through PU, PEOU, attitude or intention to use a system (e.g. Shih 2003). Not all research that has used TAM has found a direct link between PU and intention. Hsu & Lu (2004) used TAM to measure user acceptance of web sites. They expanded TAM to include a direct influence on intention from variables such as social norms, attitude and flow experience. This study also contradicted TAM in that PU did not predict intention. Geffen & Straub (2000) stated most studies that use TAM fail to show the importance of PEOU; their study found PEOU affects adoption based on the task to be performed. However Geffen & Straub acknowledged findings only accounted for 26% of the total variance therefore other factors not considered were involved. Igbaria & Iivari (1995) found experience had a direct effect on use. Self-efficacy had a direct effect on computer anxiety and PEOU, the total effect of self-efficacy and computer anxiety significantly effected PU. Malhortra & Galletta (1999) expanded TAM to account for social influence on training and use of a MS-Exchange software package. They classified social influence according to three processes of social influences proposed by Kelman (1958): compliance (expectation of reward and avoid punishment), identification (maintain identity with person or group) and internalisation (maintain congruency with value system). This study found social influence had a direct effect on attitude and an indirect effect on intention via attitude towards the use of a MS-Exchange software package. TAM appears adequate to explain adoption and use in the workplace where use is generally unavoidable or even mandatory. Vijayasarathy (2004) suggests PU and PEOU may only be dominant predictors when associated with workplace, unavoidable, mandatory use or there exists no choice over the type of system to use. Eikebrokk & Sørebø (1998) argue that both TAM and TRA cannot account for use when there are alternate options available as use is then affected by comparison of alternatives.

2.2.4 Direct effect of external variables on attitude and intention

Several studies argue that TAM needs expanding to include external variables that have a direct effect on attitude and intention (e.g. Lucas & Spitler 1999). Lucas & Spitler found in their research that the main variables in TAM (perceived usefulness and perceived ease of use) were not significant determinants of adopting a Windows-based broker workstation. They found that variables not included in the model influenced adoption and performance which were prior performance and the subjective norm. They argue that prior use is an important determinant of acceptance and that perceived usefulness had a negative relationship with the use of the system. Ease of use did not have any significant effect on system usage. Table 2.1 provides a brief summary of studies that have used TAM and their findings.

Article	Area of research	Finding
Davis (1989, 1993)	PU & PEOU as system characteristics of user acceptance for information technology.	TAM fully mediated the effects of system characteristics on use behaviour. PU accounted for over 50% variance. PU more influential in determining use than PEOU.
Chen, Gillenson & Sherrell (2002)	On-line shopping	Compatibility, PU & PEOU direct effect on attitude. Compatibility & PEOU direct effect on PU. Attitude direct effect on intention. Intention direct effect on use.
Kwon & Chidambaram (2000)	Mobile telephone use	Extrinsic motivation direct effect on PU. Intrinsic motivation direct effect on PEOU. Age direct effect on social pressure. PU, PEOU & social pressure direct effect on use.
Malhortra & Galletta (1999)	Social influence	PEOU & identification/internalisation direct effect on attitude. PU direct effect on intention. Attitude direct effect on intention.
Yang & Yoo (2003)	Cognitive and affective components of attitude	PU & PEOU direct effect on cognitive attitude. PU direct effect on affective attitude and intention. Cognitive attitude direct effect on intention.
Childer, Carr, Peck & Carson (2001)	On-line shopping	Enjoyment, navigation, convenience & PU all direct effect on attitude towards use.
Seyal, Rahman & Rahim (2003)	Academic use of the Internet.	Experience, PU & PEOU all have direct effect on Internet use.
Shih (2003)	Acceptance of e-shopping	Attitude determines willingness to use. PU & PEOU determine attitude. PEOU direct effect on PU. Satisfaction direct effect on use.
Heijden (2003)	Website usage	Attitude, PU & PEOU all have direct effect on intention. PU, PEOU & perceived enjoyment (PE) all have a direct effect on attitude. PEOU & visual attractiveness (VA) direct effect on PU. PEOU & VA direct effect on PE. PEOU direct effect on VA.
Hsu & Lu (2004)	On-line games	Social factors direct effect on attitude and intention. PU & PEOU direct effect on attitude. Flow experience direct effect on intention & PEOU. PEOU direct effect on PU. Attitude direct effect on intention.
Lopez & Manson (1997)	Use of empowered desktop information system.	Social pressure direct effect on PU & computer self-efficacy (CSE). Organisational support direct effect on PU. CSE direct effect on PU & use. PU direct effect on use.
Vijayasarathy (2004)	On-line shopping	PEOU, PU, compatibility & security direct effect on attitude. Attitude, normative beliefs and self-efficacy direct effect on intention.

Table 2.1: Summary of research findings

2.2.5 TAM considering the importance of environmental and social influence

TAM has also been criticised for ignoring the social influences on technology acceptance and use (Chen, Gillenson & Sherrell 2000). Environmental and social influences have been found to have a profound impact on user behaviour (Hsu & Lu 2004). TRA, TAM was originally based on incorporated social norms to show how social pressures can influence an individual's behaviour. Davis et al dropped the social norm construct from TAM but numerous empirical studies have found social norms and pressures have a huge impact on use (e.g. Venkatesh, Morris & Ackerman 2000; Lucas & Spitler 1999; Taylor & Todd 1999). Previous research has highlighted the importance of external variables. Venkatesh, Morris & Ackerman (2000) state sex is a key variable in the adoption and usage of information technology (IT). They found clear sex differences in determining the adoption of IT in the workplace, attitude was more salient to men for use and women were more influenced by the subjective norm. Venkatesh & Davis (1996) expanded TAM to include the influence of self-efficacy on ease of use and the system usability. Self-efficacy reflects a person's belief about their capabilities for example on using a technological system.

Nearly all research, has used TAM to measure acceptance and future use, has focussed on information technology systems within workplaces and not public zones. Generally research based on TAM has used employees of companies as participants in studies and assessed their opinions and subjective ratings on such issues as software or computer use (see Davis 1989; Igbaria & Iivari 1995 for examples). Limitations and criticisms of TAM research include sampling bias (students as participants), type of application tested and that studies do not actually measure system use but the variance in self reported use (Lucas & Spitler 1999; Legris et al 2003).

When considering human interaction with technology in public areas environmental and social influences have to be taken into account. Many external variables may impact and influence use of technological systems in public areas such as reduced levels of privacy and personal space, safety concerns and the actual location of the system. At present little is known about how environmental and social influences affect a person's willingness to use or not use a technological system. Perugini & Bagozzi (2001) suggest modification to any theory is to introduce a variable or variables that further explain how existing predictors function to influence intentions. Introduction of new constructs that mediate or moderate the effects of existing variables leads to a clearer and improved theory. Therefore it is important to find what external variables influence use and future use of technological systems in public areas.

2.3 Chapter Summary

This chapter has reviewed the literature on attitudes, attitude measurement and how they are implicated in technology adoption and use. The discussion considers how the use of attitudes in research can be used effectively. The chapter focussed on how attitudes have been integrated into HCI research by models such as TAM. Discussion with regard to TAM illustrates how TAM can be expanded successfully by inclusion in the model of external variables that have a direct effect on attitude and intention to use a technological system. It has contemplated that existing theoretical models will fail unless expanded and improved upon to take into account other external variables such as social influence.

Chapter 3

Environmental and Social Influences on Behaviour

This chapter reviews the literature on environmental and social influences on behaviour. The discussion highlights both are intrinsically linked and how they are implicated in technology use in public areas. It considers how privacy and personal space are important variables that affect levels of social interaction and use of technology. Discussion focuses on two influential models of privacy proposed by Westin in 1967 and another by Altman (1975). It describes a speculative model of privacy proposed by Burgoon (1982). A review of the personal space literature highlights how a new understanding is beginning to emerge of how environmental and social pressures influence the use of technology in public places. Finally attention is drawn to the fact that different locations are associated with distinctive influences on use.

3 Introduction

Chapter 2 highlighted how existing theoretical models e.g. TAM will fail unless expanded and improved upon to take into account environmental and social variables. This chapter reviews the literature on how behaviour can be influenced by environmental and social pressures. The discussion highlights both are intrinsically linked and how they are implicated in technology use in public areas. This is important if we are to develop an effective model of the factors that influence technology use in public places. It is also vital in the development of an effective questionnaire to measure the influence of these factors.

Humans interact with others in a variety of different environments and settings; the focus of this thesis is the interaction between people and technology in public areas.

As discussed in chapter 1 very little of the psychological of HCI literature considers the interaction between individuals and technology in public places. When individuals move among strangers the interaction is one that generally takes place without any verbal communication. Humans regulate this interaction through non-verbal behaviours that help maintain and control contact, making the interaction more comfortable and predictable (Patterson, Webb & Schwartz 2002).

3.1 Defining environmental and social influences

Previous literature does not clearly differentiate nor constitute what environmental and social factors are. For example, environmental factors can refer to personal space, clothing and buildings. Archea (1977) stated definition of the environment lacks consensus in theories. Therefore this thesis differentiates and refers to the two areas in the following ways:

- Environment: immediate location, design of system and environment, level of privacy and personal space through the amount of available space, any public place, the actual building.
- Social: interaction with others, social norms, cultural differences, density, crowding, psychological inputs and outputs e.g. expectations and interpretations, perceived levels of privacy and personal space

Several environmental and social factors are known to influence behaviour and are relevant to research into technology use in public areas e.g. levels of privacy (Pedersen 1999; Heffron 1972; Westin 1967), time and social pressure (Zimmermann & Bridger 2000) and social density (Kaya & Erkip 1999).

3.1.1 Environmental influences on behaviour

The environment can cue appropriate behaviour, motivate and stimulate a person, increase feelings of security and satisfy need. According to Rothman (1987) the environment should encourage appropriate behaviour, provide stimulation, reduce ambiguity, support and promote the intended behaviours. Behaviour can be influenced by several factors from the environment, for example, natural hazards, light, noise, temperature, buildings, colour, levels of privacy and personal space associated with amount of space (Sorenson & White 1980; Aiello & Thompson 1980; Sime 1999; Demirbas & Demirkan 2000). For example, as noise levels increase in an environment satisfaction decreases (Stone 2001).

When considering human interaction with systems found in public areas thought needs to be given to the user population, their characteristics, the immediate environment, whether the system is static or mobile, the design of the system, and the actual location. An individual using a personal computer at home is influenced by different external variables compared to an individual using an ATM in an open street. Consider the following examples of being interrupted when using a device:

- You're using a computer at home when a family member walks into the room
- You're using an ATM on a city street and a stranger begins to talk to you.

Comparison of these two examples highlights how use of technology in different places is constrained by various problems and social pressures.

Another important issue is the type of transaction for which the user utilises the system. Many public systems require the user to enter personal and private information e.g. a personal identification number (PIN) such as that needed to access financial information on an ATM. The immediate environment must support the systems intended use. Static systems like ATMs should be located in environments that afford privacy, safety and personal space.

3.1.2 Social influences on behaviour

The presence of others can influence an individual's behaviour in many ways. Their actions and expectations can exert a strong control over how an individual reacts to any situation. Social norms are powerful, invisible forces that make individuals comply to perform a behaviour in an accepted way. For example, imagine your response if you were using an ATM in a city street and a stranger began asking you questions about your overdraft. Social influence can often be indirect and unintentional, for example, how often do you enter a lift and face the back or face another occupant? Latané (1981) describes social impact as the perceived threat an individual has of the power of others and the anger he or she feels from this attack. The reaction is associated with 'any of the changes in physiological states and subjective feelings, motives, emotions, cognitions and beliefs, values and behaviour that occur in an individual, human or animal, as a result of the real implied or imagined presence or actions by other individuals' (pp.343).

Research has highlighted how social influence can be a strong force, take many forms and alter individual's perception of technological systems. Galletta et al (1995) investigated how unfavourable word of mouth statements led to negative attitudes towards a training system in comparison to when statements were favourable. They found negative attitudes were more potent then positive. Zimmermann & Bridger (2000) found users of ATMs felt under time and social pressure from others waiting in particular when in unfamiliar environments.

Depending on the task at hand generally individuals do not like being observed by other people. When using technology in public areas being observed by other people in the immediate area can cause problems (Morris et al 1995). Therefore this type of problem reduces the users perceived levels privacy, personal space and safety. To alleviate the problem of shoulder-surfing suggestions have been made that if a system is used to access private information the system should be designed so the users body conceals their interaction (Maguire 1998).

3.1.3 Summary

The discussion has highlighted how environmental and social variables can have an adverse affect on the individual. Many variables need to be considered when trying to understand human interaction with technological systems in public areas. Users of static systems such as ATMs maybe influenced by different environmental and social variables compared to users of mobile systems. For example, generally users of ATMs are dealing with very private and personal information in a public place. Therefore the amount of privacy they need from the environment maybe be higher than someone having a general conversation on a mobile phone. Negative influences on users of static systems may also be greater as the device is not a personal one. Therefore they may feel under more pressure from others who may be waiting to use the device. As more systems are developed both static and mobile, design, placement and actual location of use needs careful consideration.

3.2 Privacy – the human need

Privacy is a hot topic, widely discussed by academics and practitioners alike (Kozlov 2004). However, there is no universal definition of privacy, the concept is highly complex and involves different perspectives and dimensions. The need and desire for privacy varies between individuals, cultures, social and physical environmental factors (Kaya & Weber 2003). The desired level of privacy relates to what an individual wants and the achieved level is what they actually obtain.

Research into privacy tends to take an individualist approach and use North American or Northern European perspectives (Margulis 2003). This thesis uses the individualist approach to privacy adopted by the western world. Generally models emphasise the individuals control and choice, and social relationships as either voluntary or as barriers to independence (Fiske, Kitayama, Markus & Nisbett 1998). In the western world privacy definitions tend to involve management of personal information and space. According to Chan (2000) the ability to manipulate space is the primary way individuals achieve privacy. Several concepts have been linked to privacy e.g. self-disclosure, social comparison, social facilitation, social influence, attitude formation and change (Margulis 2003).

Privacy is a human boundary control process that allows access by others according to one's own needs and situational factors. However, privacy *is* an important human need, and if a desired level is not reached it can lead to maladaptive behaviour

(Heffron 1972). Privacy does not always refer to total isolation from others. Too much privacy can lead to alienation and too little as an invasion of privacy (Pedersen 1999). Crowding and isolation are examples of where privacy regulation has gone wrong. Situational factors can be either social (interaction from others) or physical (location, layout). Other behavioural mechanisms that are implicated to gain the desired level of privacy are non-verbal, verbal, environmental (personal space) and cultural norms.

3.2.1 Privacy and HCI

The majority of the HCI literature on privacy tends to focus on exchange and control of information over the Internet (e.g. Jackson et al 2003, Cranor, Reagle & Ackerman 1999). The actual term 'privacy' is generally used by computer scientists and security specialists to refer to the security of data against various risks or during transmission (Clarke 1999). Control of personal information is very important no matter where or what type of device is used. Individuals have a right to control and protect their personal information (Nguyen & Truong 2003).

Future systems will enable more freedom and reduce the physical constraints of time and place. According to Lester (2001) the development in technology is considered to be the main culprit in increasing concern over the protection of privacy. As new forms of technology are introduced personal information maybe accessed using a variety of different systems. For example, one individual may prefer to access details of their bank account using their interactive television set compared to another individual whose preference would be their wireless free mobile telephone. Whichever types of system people use to access personal information the concept of privacy is of crucial concern in both the informational and physical worlds.

However not everyone shares the same concern, some designers and researchers appear to ignore the importance of privacy and the net effect is has on system use. Kozlov (2004) describes a debate at a conference on Ambient Communication For Networked Devices he attended in 2003:

'...privacy design is not yet seen as a necessary requirement of a Aml design process in general, and that designers do not feel 'morally responsible' to deliver 'privacy management tools' (as stated in Kozlov 2004, pp6).

If designers of future systems fully understood how privacy impacts upon technology adoption and use they may begin to reconsider this important concept in the design process.

3.2.1.1 Privacy and information exchange

It is well documented that Internet users have major concerns regarding threat to their privacy and about who has access to the information they provide (Jackson et al 2003). Cranor, Reagle & Ackerman (1999) found 87% of users were concerned about the threat to their privacy when online. Also Cranor et al (1999) found Internet users were less willing to use sites that asked for personally identifiable information and very uncomfortable providing sensitive information such as credit card details.

Many users are aware that their privacy is at risk when using the Internet and that their online tour can be tracked. Users are aware that after visiting some sites Cookies can get implanted onto their hard drives and they then become a target for unsolicited mail. Users leave data trails almost everyday e.g. credit card use. An individual's data can be collected from the trail he or she leaves behind and few legal restrictions exist on how the data can be used (McCandlish 2002). Although several programs exist to stop personal details being sent individuals may not know how to install or use them. Recently the introduction of the Platform for Privacy Preferences (P3P) has began to change the process of how sites and companies inform users of their privacy policies.

3.2.1.2 Privacy in the physical world

When considering human interaction with technology in public places physical privacy is a very important issue. Finding how physical privacy is implicated in technology use will not only help to understand current but also future use. For example in the future individuals will be able to use systems in a multitude of different social environments and be interacting with a variety of people whether it is friends, family or complete strangers.

Concerns already exist about certain technologies used in public places. One such system found in nearly all cities is the surveillance camera. People have been 'watched' and their behaviour recorded in public places for many years. Many arguments exist for the use of such cameras e.g. crime reduction. However as advances in surveillance technologies are made many now argue that privacy no longer exists or if it does it is quickly disappearing as our activities are increasingly made public (Gotlieb 1996, Brin 1998).

Friedman et al (2004) discuss how digitally capturing and displaying real-time images of people in public places raises concerns over privacy. They undertook two investigations into privacy violations in public places through the use of web cams. Findings revealed the majority of participants showed concern over their privacy. They argue privacy needs to be protected in many contexts.

Another area of growing concern for users of technology in public places that violates their privacy is tracking. Users of mobile telephones are already aware their service provider can track their location. However design specifications in future technologies may mean it is not only the service provider who knows where you are and what you are doing. The future could see systems developed that track users to specific locations whether their device is switched on or off. Tracking will not only be available to the service provider but to virtually anyone who wants to know where the user is. Although this may be a good idea in the case of missing persons etc. it does however raise ethical issues.

Although a little removed from static technologies like ATMs the discussion above highlights how violation of privacy can impact upon use of technologies. When considering use of technology in public places we need to understand both informational and physical types of privacy and their implications.

3.2.2 Western models of privacy

Two western models that have been very influential in privacy research are the ones developed by Altman in 1975 and Westin in 1967. Altman's theory focuses on privacy as a process of regulating social interaction. Westin's approach focuses on the different types and functions of privacy. Both theories are examples of a limited-access approach to privacy (Margulis 2003). The theories both describe privacy in terms of needs and desires that are:

- Control and regulation of access to oneself
- Continuous dynamic regulation process that changes due to internal/external conditions
- Regulation can sometimes be unsuccessful
- Different types of privacy
- Culturally specific

3.2.3 Altman's approach

Altman (1975) described privacy as an ideal, desired state or as an achieved end state. If the desired state matches the achieved state then an optimal level of privacy is obtained. Privacy is obtained by selective control of access to the self. Altman suggested social interaction is at the heart of understanding privacy and the environment provides mechanisms for regulation. Altman proposed four mechanisms to achieve privacy: verbal (e.g. what is said, tone of voice), non-verbal behaviour (e.g. eye contact in communicating attitudes or intentions), environmental (e.g. personal space, physical aspects of the environment) and culture (e.g. norms, beliefs). Harris, Brown & Werner(1996) added two more components to Altman's model: cognitive (regulate interaction by focussing attention) and temporal (choose to avoid the situation by doing something else). For example, an individual may seek privacy by retreating into a room and closing a door so they can be alone. As privacy is inherently a social process behavioural mechanisms (e.g. verbal communication, cultural norms) are used as regulators. Altman (1990) argued to fully understand privacy one needs to include psychological aspects. This includes human interaction with each other, the social world, the physical environment and the temporal nature of social situations. Privacy has cultural context, psychological manifestations are culturally specific (Altman 1990). He proposed five properties of privacy:

- Temporal and dynamic process of interpersonal boundary control
- Desired and achieved levels
- Non-monotonic
- Bi-directional: inputs (e.g. noise), outputs (e.g. verbal communication)
- Process associated to either individual or group level

The interpersonal boundary control process varies with whom or what the person is interacting with and how much privacy he or she desires at any one moment in time. For example, an individual interacting within a group may seek temporary solitude to reflect and generate new ideas. Desired privacy is a subjective statement of an ideal level of interaction from others, of how much or how little contact is desired at any given moment. Achieved privacy is the actual degree of contact that results from interaction with others (Leino-Kilpi, et al 2001). Palen & Dourish (2003) argue privacy states are relative to what is desired and what is actually achieved. For example an individual can be in a crowd but feel isolated depending upon the amount of sociability sort. Altman defines privacy as non-monotonic i.e. an individual can have too much or too little privacy at anyone time. Also it is bi-directional, inputs (too much noise) can result in outputs (an individual asks someone to be quiet) this helps maintain and control the desired level. Altman's approach to privacy can be used to study privacy at the individual of group level.

3.2.3.1 Summary

Altman's approach appears to provide a complete description of what privacy is and how individuals control it. However, the approach posits fluctuations in the desired level occur according to needs no explanation is given as to why or how. Altman's model has been expanded to include other physical mechanisms in the environment that can help regulate and control privacy e.g. fences, barriers (Kupritz 2000).

3.2.4 Westin's dimensions of privacy

Westin (1967) suggested individuals use a limited-access approach to protect their privacy. He defined privacy as a dynamic process of regulation and non-monotonic i.e. an individual can have too much or too little. Westin proposed four types of privacy: solitude (being free from observation by others), intimacy (small group seclusion), anonymity (freedom from surveillance in public places) and reserve (limited disclosure of information to others). The four types serve various functions: personal autonomy (desire to avoid manipulation), emotional release (ability to release tensions from the social world), self-evaluation (ability to contemplate, reflect), limit (set boundaries) and protect communication (share information with trusted others). Westin's model has been extended several times to include other dimensions (e.g. seclusion, not neighbouring Marshall 1970). Previous research that highlights the importance of additional dimensions shows how aspects of privacy can be context-specific.

3.2.4.1 Pedersen (1979; 1999) Privacy type x privacy function model

Pedersen (1979) was the first to test the relationship between the types and functions of privacy proposed by Westin. Pedersen (1999; 1997; 1979) expanded Westin's model to include intimacy with friends, intimacy with family and isolation dimensions. Pedersen categorised privacy into six main types: solitude (freedom from observation by others), reserve (not revealing personal information about one's self to others), isolation (being geographically removed from and free from others observation), intimacy with family (being alone with family), intimacy with friends (being alone with friends) and anonymity (being seen but not identified or identifiable by others). Pedersen suggests that the six types of privacy 'represent the basic approaches people use to satisfy their privacy needs' (p.404). Pedersen proposed five functions of privacy based on Westin's model: creativity (e.g. brainstorming, problem solving), contemplation (e.g. to mediate and reflect), rejuvenation (e.g. recover and protect from what others may say), autonomy (e.g. experience failure), confiding (e.g. share personal ideas, confide in others you trust). Pedersen posits the type of privacy x privacy function model highlights the link between the type of privacy people need and the reason why (i.e. function). However he did acknowledge the model needed to be empirically validated. Table 3.1 provides a schematic depiction of Pedersen's model.

		Privacy Function				
		Autonomy	Rejuvenation	Confiding	Contemplation	Creativity
Privacy Type	Solitude					
	Reserve					
	Anonymity					
	Isolation					
	Intimacy with friends					
	Intimacy with family					

Table 3.1 Pedersen (1999) Privacy type x privacy function model

3.2.4.2. *Summary*

The dimensions proposed by Westin and Pedersen have been criticised as too confusing and overlapping (Burgoon 1982). The dimensions appear to ignore physical privacy i.e. the degree to which an individual is physically inaccessible. All of the proposed dimensions implicate psychological functioning therefore no clear differentiation between other types of privacy such as informational. The types of privacy describe interaction with others that occurs in controlled situation and ignores unwanted input. The model appears to place isolation at one end of the spectrum and crowding or personal space at the other; this does not cover all aspects of privacy or the different types.

3.2.5 Burgoon (1982) – speculative approach

Although speculative, Burgoon (1982) suggested four dimensions of privacy: physical, psychological, social and informational. The physical dimension relates to how physically accessible a person is to others and can be linked to such aspects as environmental design. The psychological dimension refers to a person's right to decide with whom they share personal information and the control of cognitive/affective inputs/outputs such as non-verbal communication. This dimension is related to social privacy and protects the individual from undue mental pressure, fatigue and excessive sensory stimulation. It acts as a temporary buffer from outside sources that may cause emotional, mental or psychosomatic stress. Freedom from thought and social interaction increases personal autonomy. Psychological privacy allows the individual to reflect, interpret and evaluate actions or events. It does not always refer to total isolation but time and opportunity to develop ideas. The social dimension is the ability to control social interactions by controlling distance between people. This dimension is associated with physical privacy and often a natural consequence of it. An individual can decide whether or not to socially interact with others. Social privacy has two main functions: managing social interaction and establishing future plans or strategies (Altman 1975). Social privacy acts an escape mechanism, physical privacy may be considered low in a crowded situation but social privacy high. The individual has the choice as to whether or not they interact with others. Therefore he or she can remain anonymous by not revealing any personal identifiable information and keep the probability of any interaction with others low. The informational privacy dimension relates to a person's right to reveal personal information to others, which is not always under a person's control. In today's world there exists a serious threat to informational privacy from data gathering about individuals from private companies to government records. For example, the use of a credit card or the Internet leaves a data trail full of personal information. An individuals daily habits and history are potentially accessible to others without direct permission or even knowledge. Control is needed so the individual can decide whether to release or distribute such information and to whom, how much and what type.

Burgoon (1982) proposed six types of control which people use while interacting with others: physical barriers (e.g. walls), space (e.g. personal), territory -control by time and function (e.g. place coat on chair in library), body language or vocal cues, appearance or clothing, verbal mechanisms (change topic of conversation).

3.2.5.1 Summary

Although Burgoon's approach to privacy is speculative it lacks explanation of control over the various dimensions. For example, information pertaining to the social and physical aspects can be temporal i.e. an individual can choose to reveal a certain amount of information at any one time and control the level of interaction e.g. walk away. In comparison, once an individual reveals any type of information in the informational and psychological dimensions he or she is no longer in control of it and cannot take it back.

3.2.6 An example of cultural variation

From a cultural perspective, Kaya & Weber (2003) investigated differences in desired levels of privacy between American and Turkish students. They found American students had a significantly higher need for desired levels of privacy compared to Turkish students. They reasoned the difference was due to the American culture having more emphasis on individuality and autonomy in comparison to Turkish culture that has stronger inter and intra familial ties. Therefore Turkish students were more accustom to adapting to life in socially dense environments. However they posited regardless of culture if privacy is not met individuals feel more crowded, when the desired level of privacy is achieved the perception of crowding decreases.

3.2.7 Privacy regulation

The regulation of privacy is complicated due to the range of functions it maintains and protects. Levels of perceived privacy can be increased or decreased dependent upon an individuals experience, expectation, other people in the area, the task and the physical environment. Regulation is considered as a dynamic process with variable boundaries that are under continuous negotiation and management, continuously refined according to circumstance (Palen & Dourish 2003). Generally individuals rely on features of their spatial world and the immediate environment. Regulation and control can also be sort by verbal and non-verbal behaviour. For example, imagine an individual who wants to have a private telephone conversation, he or she may close a door and talk quietly to try to achieve a comfortable level. The individual would expect others to follow the social or behavioural norms of behaviour and not interrupt the conversation. Although no formal rules exist social and behavioural norms help protect and maintain privacy.

Altman (1975) describes privacy as a boundary regulation process that ranges from open to closed. The ultimate goal of privacy regulation is to modify and optimise behaviours to achieve the desired level along the open/closed spectrum. Individuals optimise their accessibility by regulating the amount of privacy they require in any given context.

Demirbras & Demirkan (2000) used Pedersen's types of privacy for research into privacy regulations used by people in a design studio taking into account spatial characteristics such as the amount of personal space and the effect these factors have on preference for an environment. The studio was open plan although certain physical features such as columns gave the users the opportunity to be by himself/herself and to create private corners within the studio. Therefore the studio afforded both the possibility of both social interaction and avoiding social interaction. They found the definition of privacy differs between individuals and the type is dependent upon situation and culture. They also suggested that the use of partitions does affect levels of satisfaction. This latter statement supports research by Oldham (1988) that when partitions are used effectively this can increase perceived privacy and satisfaction.

3.2.8 Summary

Privacy research has suffered from lack of consensus regarding the different dimensions, functions and definitions of what 'the environment' actually exists of. Concerns have also be raised in privacy research due to the actual concept itself i.e. individuals both protect and manage it (Pedersen 1999). Archea (1977) pointed out that in the environment-behaviour literature ten different definitions of 'the environment' existed ranging from physical structures to personal space. No one theory fully describes the objective, physical environment or how environmental concepts are associated with the independent psychological descriptions of privacy (Margulis 2003). Margulis states a complete explanation of privacy needs is required to understand how social activity is situated in context where objective, physical characteristics often affect behaviour.

Levels of control and actual context of the interaction all have a major affect on use of technology and the user. Control over how far others come near or what they see is needed; this is related to the self and information about the self per se to achieve privacy and an optimal state. Latané (1981) stated that people become inhibited by surveillance of others and the first person to observe someone's behaviour in a social field has the greatest impact compared to the next observer. Even from evolutionary viewpoint humans prefer shelter or a type of enclosure for freedom from observation by others. However, the concern over privacy is increasing especially in relation to both the technology and use. Already devices added to mobile telephones e.g.

cameras are banned from certain places. Therefore in public places perceived social pressure and reduced levels of privacy may increase.

3.3 Personal Space – the silent language

Humans interact according to social convention; public order is maintained by following rules of behaviour (Brower 1980). Cultural 'rules' inform self and others of what behaviours are appropriate for persons performing a type of behaviour in any given situation (Rashotte 2002). For example accepted behaviours at a religious service differ greatly in comparison to accepted behaviours at a football match. Rashotte suggests that non-verbal behaviours possess affective meanings and influence how people perceive other components of a situation. Non-verbal behaviours are used in a covert way to protect, control, communicate and regulate interactions with others. For example a person will avoid eye contact and shift his or her body orientation away if someone invades his or her personal space. Imagine your friend revealed personal information about you to others. You ask her if she did – she denies the allegation but you notice she glances down and looks embarrassed. What do you believe her words or actions? According to Burgoon, Buller & Woodhall (1989) 60% of social meaning in human interaction is transmitted non-verbally.

One important non-verbal behaviour is personal space which refers to how people maintain distance from others; generally a common sense understanding of shared space often emerges. Aiello & Thompson (1980) state the two primary functions of personal space are regulation or control and communication. Personal space protects against the possible uncomfortable psychological or physical encounters by regulating and controlling the amount and quality of sensory stimulation. Personal space communicates to others information about the relationship, the formality of the interaction by the use of cues to the preferred chosen distance. In 1908 Simmel stated that invasion of an individuals personal space produces a contradictory experience, as it shows what it means to interact socially with someone who is both near in a spatial sense yet far in a social sense:

> *'The unity of nearness and remoteness involved in every human relation is organised in the phenomena of the stranger, in a way which may be most briefly formulated by saying that in the relationship to him, distance means that he, who is close by, is far, and strangeness means that he, who is also far, is actually near. For, to be a stranger is naturally a very positive relation; it is a specific form of interaction.*
>
> (Simmel 1950b: 402-3)

However inappropriate distance and the subsequent reactions to it have potent impact on the communication process (Burgoon & Guerrero 1994). Cultural differences in the preferred level of space can result in confusion. Interpersonal distances vary according to whom or what the person is interacting with. Personal space is generally referred to as interpersonal distance, which marks a boundary between self and others both in a literal psychological sense and also a social sense. Therefore space not only creates settings for appropriate behaviour but enable/disables privacy and facilitates/inhibits interaction from others.

Love (2001) carried out an exploratory investigation into invasion of mobile telephone users personal space. The users of the mobiles were confederates of the experimenter. Conversation type either private or social was manipulated. Love found people adopt behaviours to cope in a situation with a stranger who is talking on a mobile phone. Bystanders either feel comfortable and listen to the conversation or uncomfortable i.e. they move away. Love suggested individual differences may be related to how people react.

3.3.1 Summary

The use of technology in public areas is growing. However increased use may see changes in how individuals react. For example, face-to-face interactions in public are common but interacting with someone in two different types of space i.e. conversational and physical becomes confusing. As more systems are introduced in public areas will peoples attitude towards how they interact change? Will the benefits different systems bring reduce the accepted personal space distances? Already mobiles have been classed as an extension of our personal space (Polaine 2002). At present technological change is fast while attitudes appear to remain stable. This thesis highlights the importance of personal space as a main variable that influences use of systems in public areas.

3.3.2 Personal space measures

Hall (1969) specified four interpersonal distance zones: the intimate zone generally reserved for intimate/private relationships and extends from 0 to 30cm, the personal zone still allows considerable amount of interaction but extends from 30cm to 120cm. The personal zone can be further split in two: 30cm – 75cm the closer phase still permits a rich exchange of touch, smell etc. and is thought to be reserved for intimates and the far phase of the zone extends from a point that is just outside easily touching distance 76cm – 120cm. The third zone Hall classed as the social zone this extends from 121cm to 360cm and is used for more casual, impersonal relations. The final public zone, beyond 360cm is classed as appropriate for formal meetings and interaction with high status people. However these zones vary between cultures, individuals, and sex (Altman & Chemers 1989). Males have been found to use larger distances than females (Kaya & Erkip 1999; Gifford 1982), extroverts are prepared to use less space than introverts (Anderson & Sull 1985), aggressive people have been found to use more space (Fast 1971), when people are attracted to each other they use less space and more space with strangers (Little 1965). Past research into cultural differences has revealed that European and Caucasian Americans use more distance in public especially with strangers compared to non-western European cultures (Aiello & Thompson (1980). However the fact that international travel is now commonplace cultural differences in the use of personal distance have become less divergent.

Personal space has been likened to a personal bubble that surrounds the body that either expands or contracts dependent on the type of interaction and the situation (Hall 1969). The bubble is wider at the front of a person than at the back (see Figure 3.1).

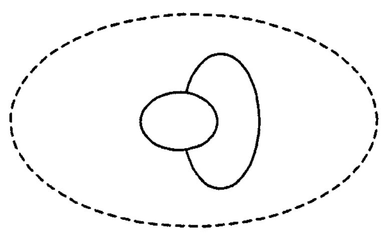

Figure 3.1: Example of the idea of a personal space bubble

Hayduk (1983) argued that the bubble analogy was weak, as it did not explain the gradients of resistance that accompany intrusion. He suggested the description was misleading as when two bubbles press against each other their surfaces repel one another. Where as when referring to personal space an individuals body is repelled not the boundary of the bubble. Also bubbles are prone to bursting – no description is explained for this phenomena. Patterson (1975) argued that research should let the bubble burst and select a new personal space analogy. However the bubble analogy provides an abstract description and helps visualisation. For example, intruders can be thought of as not having a bubble when they invade an individual's space, this can help our understanding by visualisation.

3.3.2.1 Measurement techniques

Generally four techniques have been used to measure personal space: chair selection – a person chooses a seat at varying distances to a target; stop distance- a person tells an experimenter when a confederate is to close and they feel uncomfortable; projective techniques- the manipulation of dolls and figures and observational studies (see Hayduk 1983). However some of the latter techniques are both problematic and questionable.

Hayduk (1983) stated that projective techniques used to measure personal space have resulted in unacceptable low correlations with real life behaviour. When people state measures of preferred spacing they are unable to maintain their initial measures when asked to repeat the procedure. Hayduk (1981) used a stop distance procedure to measure personal space that included eight different body orientations (see figure 3.2 for an example). A confederate stood on a central point and a participant approached him along all of the different orientations. In one experiment the confederate had to look straight ahead when approached by the participant and in another the confederate was allowed to turn their head towards the participant when they approached. Hayduk found that tolerable personal space distances are dependent upon visual mechanisms related to head orientation therefore personal space is flexible. When approached from the front participants stated that a distance of around 70cm resulted in feelings of slight discomfort, around 50cm moderately uncomfortable and 30 cm very uncomfortable. Hayduk suggested that the results provided an explanation why personal space is smaller for rear zones.

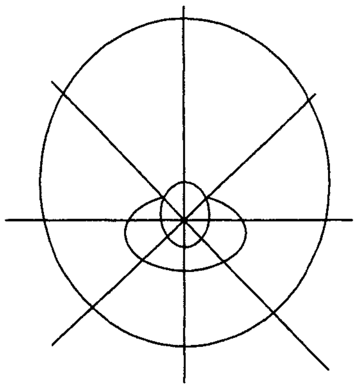

Figure 3.2 : Example of the eight body orientations used to measure personal space in pastresearch such as Hayduk (1981)

Nakauchi & Simmons (2002) carried out similar research to Hayduk. They had people stand 200cm away then walk towards another person until they felt uncomfortable they also collected data for eight body orientations. They found that human personal space measured 83cm at the front, 40cm at the back and 60cm at the side. The results support previous findings that personal space is roughly an oval shape and larger towards the front.

3.3.2.2 Summary

Most research has studied the effects of personal space invasion in temporary conditions e.g. such as chair selection in public places. Generally findings show that people leave the area or task when their space has been invaded (see Felipe & Sommer 1966). Such research highlights how an individual leaves a public space area, as public space fosters no lasting importance to the temporary owner (Brown 1987). Ruback (1987) argues that leaving a space especially in public areas is dependent upon the task at hand. If the task is place specific and no alternatives exist nearby then an individual will persist on finishing his of her task. Technology use in public places is a temporary phenomenon. This thesis explores how invasion into personal space affects the user of systems in public areas. It questions whether reaction to invasion may be related to individual differences.

3.4 Social Density – effects on space and privacy

Situational factors have also been found to influence interpersonal distance. Situational variables can either refer to the social situation or the individual's psychological state. Stokols (1972) described a basic distinction between density and crowding: density refers to the physical condition which involves space limitation (i.e. the amount of physical space per person); crowding relates to the individuals subjective experience associated with a feeling of lack of control over the physical environment. Crowding refers to an individual's psychological state that may or may not accompany dense spacing. Kruse (1985) suggested the concept of crowding derived from several influences: lack of space (Stokols 1972), excessive stimulation (Desor 1972), unwanted behavioural interference (Schopler & Stockdale 1977), the need for privacy (Altman 1975) and invasion of personal space (Rodin 1986).

However in crowded situations such as lifts people cope by treating the other people around as non-persons or objects as objects as such cannot invade someone's personal space (Sommer 1969).

Gifford (2002) defined two types of density social and spatial. Social density is used to describe an increase in the number of people while space remains constant. Spatial density refers to any change in the amount of space and no change in the amount of people. Differentiating between social and spatial density allows for comparison between settings and whether effects are due to amount of people or space. Spatial density is more comparable to personal space and helps visualise the link between personal space and crowding (Hayduk 1983).

As social density increases crowding can cause discomfort, stress and reduced levels of privacy in particular when it is related to intrusion into one's own personal space. People experience high density more negatively in their primary settings when they view other people responsible for inconveniences (Rodin 1986). Kaya & Erkip (1999) suggest discomfort arises due to the same amount of resources distributed to a higher number of people, more physical interference is encountered therefore an individual lacks control and privacy is reduced. Knowles in 1979 argued that it is not density per se but the proximity of others that is important. High density affects an individual's behaviour more compared to when density is low. For example, in high-density where the amount of space may be limited an individual may experience movement restrictions and invasion of privacy (Kaya & Weber 2003). In comparison an individual at a football match may not feel crowded although density is high.

3.4.1 Theoretical approaches to crowding

Two main theoretical approaches of crowding exist: stimulus overload and behavioural constraint. The Stimulus Overload theory (Desor 1972) proposes that through unwanted or inappropriate social contact with other people an individuals arousal levels increase and they respond to the situation in a negative way. The theory posits that if an individual evaluates the physical environment as crowded he or she will feel harassed by the presence of other people. Also any change in the physical conditions of the environment affect the individual's perception. Lee & Graefe (2003) state the Stimulus Overload model is based on high-density conditions as people meet more stimuli than they can handle and therefore lack control. The Behavioural Constraint theory (Stokols 1972) suggests when an individual experiences any form of interference with his or her activity from other people in the immediate environment they perceive the situation as crowded. Both approaches define crowding as a psychological state where an individuals demand for space exceeds the available supply (Horn 1994). Baum & Paulus (1987) argue that density levels and interaction with others are more important factors than limited space.

The Social Interference theory (Schmidt & Keating 1979) supports the idea that density is more important than space. They suggest crowding occurs when the level of density interferes with an individual's activity or goal. The interference affects the individual's ability to control the situation which in turn affects their goal. Gramann (1982) purports an individuals behaviour is generally goal orientated, crowding attributes when number and behaviour or nearness of others are incompatible and therefore interfere with the goal attainment.

Lee & Graefe (2003) state how an individual interprets the situation and what he or she expects from it can result in feeling crowded in low-density conditions. Although crowding is influenced by density other variables need to be taken into account: situational, subjective, geographic and experience.

3.4.2 Individual Differences and space

Johnson (1974) stated the level of contact an individual needs is a function of personal and situational factors. Personal factors include need, personal attractiveness, interpersonal skills i.e. verbal/non-verbal behaviour, personality variables and ability to use privacy control mechanisms i.e. personal space. Situational factors are divided into two types: social and physical. Social refers to the presence of others, their willingness and personal characteristics who may interact with the individual. Physical environmental factors refer to such artefacts as barriers or walls.

Sinha & Nayyar (2000) looked at the effects of self-control and social support in elderly people living at home in either high or low-density living conditions. If people sense they are more in control of a crowded situation negative effects from the environment are reduced. Sinha & Nayyar found that people with high self-control perceived they were more in control of a situation when personal space decreased and density increased. Therefore people with high self-control and less personal space are more likely to see events as controllable and predictable. The results support previous work by Lawton (1988) in that individuals with high levels of competence have a 'greater capacity to interact with the environment in ways that facilitate adoption'.

3.4.3 Context

The context of an interaction is known to be a major factor in determining the reaction of an individual to an invasion of their space (Harris, Luginbuhl & Fishbein 1978). In certain high-density conditions, if a person feels crowded or their personal space has been violated they often try to avoid further social contact or even socially withdraw from the situation. Certain behavioural changes are noticeable in these circumstances such as making postural changes, moving away, less verbal communication (Sundstrom 1975), avoiding eye contact (Hall 1969), or increasing personal distance (Baum & Paulus 1987).

According to Harris et al the resultant changes in behaviour when personal space has been violated are more plausible in low density than in high. They state that people are likely to feel more threatened by invasion into their space in low density as the intrusion can been classified as 'intent' by the intruder. Compared to when density is high and the intrusion may be classed as 'accidental' due to insufficient space. Harris et al's study highlighted the fact that males were more likely to react e.g. look over their shoulder to intrusions in low density compared to high-density intrusions. They concluded that males are more sensitive to personal space invasion from behind than females. McBride, King & James (1965) found that invasions from behind produced lower galvanic skin responses compared to frontal or side invasions.

Kaya & Erkip (1999) studied the effects of short-term crowding on the invasion of personal space at an ATM in America. They found that people feel uncomfortable if approached at a distance they consider to be to close and in high-density conditions people are more disturbed by the presence of others than in low-density due to the invasion of their personal space. They also found people in high density perceive there to be less available space and withdrawal behaviours increase.

3.4.3.1 Waiting in line

Often situational factors mean that a person at some point may co-exist in a space with another person with whom they don't want to interact with such as waiting in a queue. Soman & Zhou (2002) suggest queues are ubiquitous as everyday we may find ourselves in one. Although waiting in a queue is a matter of social convention a person can get very irritated by thoughtless invasion into his or her space by someone else. Milgram, Liberty, Toledo & Wackenhut (1986) suggested that a queue constitutes a small scale social system that possesses three distinguishing features: regulates sequence in which people gain access to goods or services, it consists of a distinct spatial form and maintenance depends on shared knowledge of standards of behaviour appropriate to that situation. Brady (2002) states that the single most important feature of queues is their reliance on trust and co-operation.

Bennet (1998) suggested waiting in line produces restfulness, tension and anxiety, as people tend to dwell on negative thoughts e.g. being late for next task. Baron & Rodin (1978) suggested that as individuals lack control over the situation they cannot move around freely (i.e. they would lose their place) and they might be forced into close physical proximity with non-favoured others. Bennet studied people in queues at supermarkets (short wait situations) and found people with Type A personality were more averse to queuing than people with Type B personality. Type A personality refers to individuals who tend to act impatient, hostile and competitive. In comparison Type B personality refers to individuals who tend to be relaxed and easy-going.

Larson (1987) suggested that waiting in line could be a positive experience if the person queuing is kept occupied or entertained, as 'filled time' appears to pass quicker than 'empty time'. Pruyn & Smidts (1998) suggest satisfaction of service or goods is affected by individual's perception of waiting time. They believe an individual's perception of waiting in a queue is influenced by two components: cognition and affect. The cognition component reflects the perception of time while the affect component reflects the emotional response of waiting e.g. irritability, stress. Pruyn & Smidts suggest acceptable waiting time may be determined by situation specific variable (e.g. if the individual is in a hurry) and or trait like properties (e.g. impatience). Research has also found that when an adult waited in a queue and their rear space was invaded by a five year old they responded more positively than when their space was invaded by a ten year old child (see Fry & Willis 1971; Dean, Willis & LaRocco 1976).

Nakauchi & Simmons (2002) have recently designed a robot that can stand 'in line' in a queue without invading people's personal space. They propose a model of lines of people using the notion of personal space. The research describes how experimentally they found an estimate of size and shape of personal space for the task of standing in line. When people queue they tend to stand face forward towards the person in front at the same timing maintaining enough distance so as not to feel uncomfortable, but near enough so no one else can push in. Hayduk (1983) stated that people move closer when facing someone's back compared to facing his or her front. Zhou & Soman (2002) researched the phenomena of the queue and found that the number of people behind influenced the value associated with the queue position, satisfaction with the service, and affected the decision whether or not to leave the queue. They studied people queuing at a Post Office and manipulated the number of people in the queue, ranging from 0 to 10. The more people behind the more positive the individual's mood, his or her level of satisfaction and the less likelihood of leaving. The more people in front was associated with less satisfaction and higher likelihood of leaving. They discussed the results in terms of downward comparison i.e. the people behind are worse off. Zimmermann & Bridger (2000) found ATMs users who were alone or had to wait in a queue before use were conscious of others waiting which resulted in perceived time and social pressure. However, there appears to be no research into people's subjective feelings of the effects of people behind when queuing, in particular when a person is dealing with personal information.

3.4.4 Summary

Individual differences, situational, subjective, geographic and levels of experience can all have an affect on technology use. As systems are under continuous development and service providers add more and more information and components these need to be considered. For example, the facility to add airtime to mobile telephones found on some ATMs may change users perception of the device. ATMs are considered a fast, reliable walk up and use service, however adding certain facilities slows the transaction time resulting in longer waiting for other users. Other people waiting to use systems can exert a powerful influence and increase negative states in the user. This thesis supports the view of Knowles (1979) in that it is not density per se but the proximity of others that influences use of technology in public areas. Also the work of Lee & Greafe (2003) in that individual interpretation and expectation influence the perception of crowding.

3.5 Location

Humans are territorial creatures and need a certain level of security, comfort and safety from their immediate location (Valentine 2001). Altman (1975) classified territory into three types: primary, secondary and public. Primary territory is central to the lives of its occupants, is occupied consistently and often personalised. Physical and psychological retreat takes place in primary settings e.g. an individual's home. Secondary territory refers to semi-public places where generally occupants follow informal rules e.g. an office. Public territory refers to any public area where generally behaviour is governed by social norms. Ruback, Pape & Doriot (1989) state that different types of territory exercise different levels of control. People generally have permanent control of their home e.g. they can lock the door to stop others entering. In comparison public territory is controlled for a very short time period, almost anyone can gain access and temporary control of such an area. People tend to defend temporary public areas if the resources or a task needs to be performed at that particular location. Therefore people will persist on a task in a public area if no alternate resources are nearby.

Ruback et al found the presence of others affects the length of time people take to use a public telephone. Their results showed that people tended to take longer on the telephone when someone else was waiting to use it. However, they suggested that different locations are confounded with different time pressures and particular types of people.

Recent research has highlighted how the use of a mobile telephone in a public area can disturb bystanders. According to Wei & Leung (1999) mobile telephone use in public places is very annoying. Their research highlighted use in restaurants, libraries, airports and trains were all rated high for annoyance. Ling (1997) investigated the use of mobile telephones in restaurants. Customers perceived use of mobiles in these locations as a social violation. Even though background noise was often sufficient to cover the conversation, ring tones, loud talk and only hearing one side of the conversation were all classed as disturbances. Monk et al (2004) investigated the difference between face-to-face conversations and mobile telephone conversations in public places. They found even when volume in both conditions was controlled mobile conversations were still perceived as louder and therefore more annoying. Palen et al (2000) support Ling's findings but suggest bystanders are more tolerant if they are experienced users. Churchill & Wakeford (2001) stated the type of conversation individuals have on mobile telephones in public places is different to ones they would have in a different place with no one else around. When mobile users decide to make or receive a call they are considered to violate social norms of their immediate physical environment to honour norms in conversational space (Palen 2002). As systems become more ubiquitous and free the user from time and place, research suggests that although anytime, any place maybe possible it may not always be acceptable (Perry et al 2001). Anytime, anywhere access invades on social life and therefore raises problems for both user and bystander.

Public space technologies are now used in a host of different environments from the city street to public bars. For example, new locations of ATMs are now on the increase and can now be found in a variety of different public places. Using an ATM is a personal and generally private activity however new locations may affect people's willingness to use them due to a decrease in the amount of personal space and privacy. In some of the new locations such as local stores there is less personal space available therefore a reduction in an individuals level of privacy when carrying out a transaction. For example, recently ATMs were attached to Kofi/Kash kiosks and located on Metro concourses around the Newcastle area in the North East of England. At these kiosks not only were the ATMs attached to coffee kiosks but also an individual using the ATM was only a small distance away from others buying coffee and snacks. Therefore their levels of privacy and personal space were reduced. However people may favour the new locations even with reduced levels of personal space as they may feel new sites are safer as actually attached to a kiosk where someone is working.

With the current and future trends in the development of new types of static and mobile technology people's attitudes may change, as they become accustomed not only using ATMs but also receiving personal information in new locations and perhaps on a variety of mobile technology. Lash & Urry (1994) state that new forms of social distance will have to be learnt with regard to the changes in technological mobility. Therefore finding the factors that influence people's perceptions of use is an important area not only for current use but also in trying to predict future use of technological systems in public zones.

3.6 Chapter Summary

This chapter has reviewed the literature on environmental and social influences on behaviour. The discussion highlighted how social pressure can often be a strong invisible force. It illustrates the importance of understanding factors such as privacy and personal space and how they are intrinsically linked. The chapter demonstrated a new understanding is beginning to emerge of how environmental and social influence affect the use of technology in public places. The discussion in chapter two illustrated how TAM can be expanded successfully by inclusion in the model of external variables that have a direct effect on attitude and intention to use a technological system. The review in this chapter highlights the importance of how external variables can influence the use of technology in public areas. As technologies change and become more ubiquitous people will use them anytime anyplace, receiving and sending information in a variety of different environments. There exists a real need for the HCI community to develop theory regarding use of technological systems in public areas, not only to add to the literature but also provide practical future applications.

Chapter 4

What affects technology use in public areas? -an exploratory investigation

This chapter describes an exploratory investigation into trying to understand how and what factors influence the use of technology in public areas. The study incorporates findings from previous literature discussed in chapters two and three of this thesis. Although exploratory, findings show individuals subjective feelings of privacy, comfort and experience play a major role when using an ATM in a public zone. However, results are approached tentatively due to various limitations with the research.

4 Introduction

In chapters 2 and 3 this thesis evaluated attitudes, technology acceptance, social and environmental influences on behaviour. The review illustrates that very little of the HCI or psychological literature considers the interaction of people and technology in public areas. Key challenges were identified in chapter 2 related to the need for TAM to be expanded to account for social and environmental influences on behaviour. Chapter 3 identified how these factors can be a strong invisible force and influence individuals' behaviour in many direct and indirect ways. Therefore several challenges are set out in this chapter:

- To combine HCI and psychological approaches to further understand human interaction with technological systems in public areas
- To explore, evaluate and consider how external variables fit in relation to TAM
- To consider how and what variables affect the use of public space technologies, in this case the ATM

In the past ATMs have generally been located in 'holes in the wall' outside banks and supermarkets, however they can now be found in a multitude of different locations from city streets to public bars. At present there exists a relatively poor understanding of how social and environmental factors influence ATM use. As ATM location diversifies and the range of tasks supported by the system increases, the importance of socio-environmental factors becomes more salient.

4.1 Variables of interest

From the literature reviewed earlier several variables emerged that may influence the use of ATMs in public places. Table 4.1 provides an overview of the variables of interest and their source.

Source	Variable(s)
Davis (1989) TAM	PU, PEOU, Attitude, Intention, Future Use
Pedersen (1997; 1999); Demirbas & Demirkan (2000)	Privacy
Kaya & Erkip (1999); Hall (1969)	Personal Space
Rothman (1987)	Safety
Igbaria & Iivari (1995)	Anxiety
Latané (1981)	Awareness
Valentine (2001)	Security
Igbaria & Iivari (1995)	Experience

Table 4.1: Source of variables measured in this exploratory study

4.1.1 TAM as a framework

A comprehensive evaluation of TAM was outlined in chapter 2 of this thesis. TAM addresses certain system characteristics i.e. perceived usefulness and perceived ease of use that may emerge as major factors when considering the use of technology in public places especially ATMs. Previous research has already documented that ATMs are both convenient and useful public space systems (e.g. Leblanc 1990). ATMs are classed as a walk up and use service and the majority of people do so without any prior training or instruction. Therefore public space systems must inevitably be easy to use. Although TAM ignores the fact external variables may have a direct influence on attitude and intention to use a system, the model has been empirically validated numerous times. Therefore TAM appears an appropriate method to use when trying to explore and understand human interaction with technology in public places.

4.1.2 Considering other source variables

The literature review in chapter 3 discussed how social and environmental factors can influence an individual's behaviour. Several variables surfaced that need to be considered when trying to understand human interaction with technology in public places.

As using an ATM is generally a personal activity an important variable that requires further investigation is privacy. Individuals need to be able to control and maintain a desired level of privacy to make any interaction comfortable and safe. Control over how much, if any, personal information is revealed to others and the amount of personal space are both implicated when considering ATM use.

Some of the privacy types proposed by Pedersen (1999) are appropriate when related to ATM use: solitude (freedom from observation by others), anonymity (being seen but not identified or identifiable by others), reserve (not revealing personal information about oneself to others) and isolation (being geographically removed from and free from others observation).

The research by Kaya & Erkip (discussed in section 3.4.2.3) highlighted how invasion of personal space affects users of ATMs more in high-density conditions compared to low-density conditions. Kaya & Erkip also found in high-density conditions people utilise smaller interpersonal distances when waiting in a queue. However Harris et al (1978) state personal space invasion in high density is more acceptable compared to when density is low as this is classified as 'intent'. These conflicting findings suggest personal space invasion in low or high density may be task dependent. Research in this thesis considers this phenomenon.

As discussed in chapter 3 humans need a certain level of safety (Rothman 1987) and security (Valentine 2001) from their immediate environment. Latané (1981) discussed knowledge and awareness of others and the immediate environment helps our understanding of how to react in any given situation. Holt & Spencer (2004) stated 'street robbers' define the ATM as a good area in which to identify and target victims. They suggests a number of reasons for this, the victim is considered 'cash rich' on leaving the ATM, they are distracted by the activity of withdrawing money and less likely to take account of their immediate environment. In part, this thesis agrees with Holt & Spencer but argues in certain environments and contexts users are more aware of their immediate surroundings and the task at hand.

Anxiety has been found to be a major predictor of technological adoption and use. Igbaria & Iivari (1995) purport computer use is linked to levels of anxiety and experience of the actual user. Anxiety can be split into two categories: trait-based (personality tendencies which are stable over time and situation) and state anxiety (a response to a situation). According to Igbaria & Iivari (1995) computer anxiety is a form of state anxiety that results in an individual suffering from 'irrational emotional distress' when contemplating the use of IT systems. Computer anxiety has also been determined as a key variable related to perceived ease of use and usage (Gilroy & Desai 1986). All of the variables discussed above appear to be very important when considering an individual's interaction with an ATM.

4.2 Aims of investigation

Although the study is exploratory the aim is to find answers to the following questions:

- Do people using or queuing to use an ATM in high-density conditions show an increase in withdrawal behaviours e.g. make more postural changes, look around, increase interpersonal distance due to crowding than participants in low-density?
- Are factors such as privacy and security perceptions, available space, experience, ease of use, usefulness, awareness of others and anxiety an important influence on use and in predicting current and future use of ATMs?
- How can TAM be modified to account for social and environmental influences?

4.3 Methodology and materials

This present investigation into ATM use consisted of two parts: firstly observations of people waiting to use or using an ATM attached to a Kofi/Cash[1] kiosk, secondly a survey on people's attitudes towards using an ATM and their subjective ratings of levels of privacy, personal space and anxiety, awareness of others, safety issues, experience and future use.

4.3.1 Location

This study looked at ATM use in a location that was comparatively new at the onset of the study – ATMs attached to Kofi/Cash kiosks[1] on Metro concourses in Newcastle, UK. The Metro is a part underground railway system in Newcastle and surrounding area. An individual using the ATM at the kiosk was only a small distance away from others buying coffee and snacks therefore their levels of privacy and personal space were reduced. However people may favour these types of locations. For example, the Kofi kiosks ATMs were adjacent to where someone was working. Therefore users may benefit from an increase in perceived safety at the cost of a reduction in the amount of personal space.

Both studies were carried out at several ATMs attached to Kofi/Cash kiosks (see Figure 4.1) in the following Metro concourses in Newcastle upon Tyne, England: Haymarket, Heworth, Monument and South Gosforth.

[1] Kofi/Cash kiosks no longer exist on Metro concourses. They appeared to stop trading in mid 2002 the author is not aware of the reason for their closure.

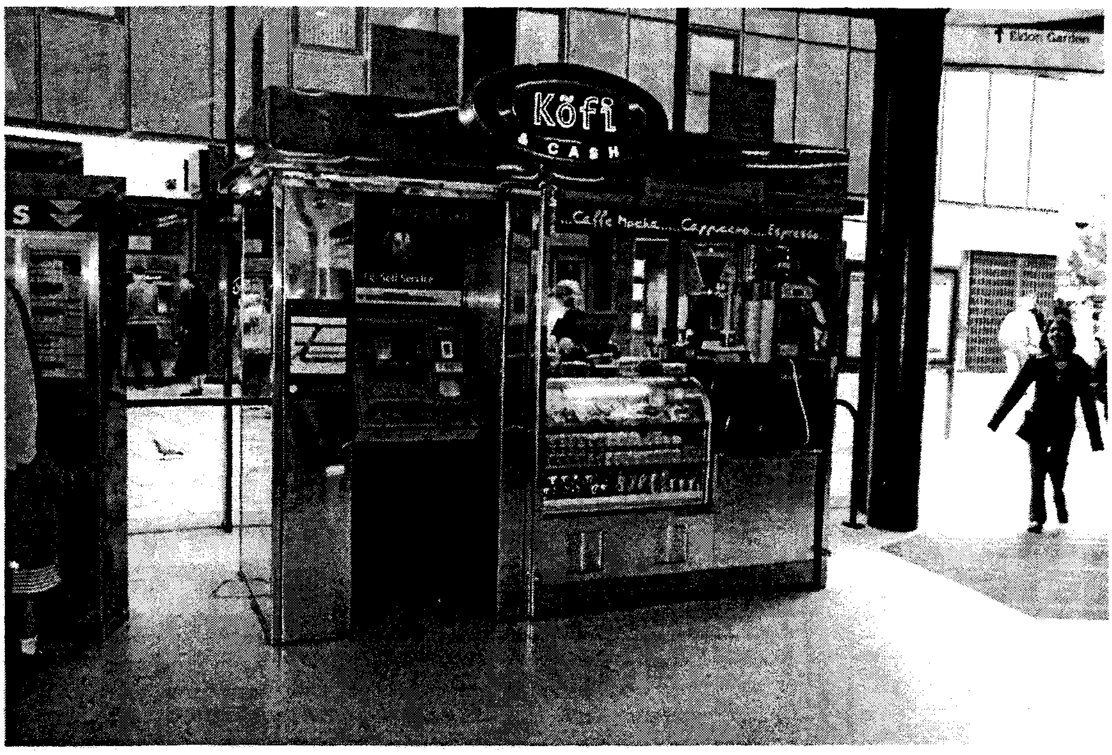

Figure 4.1 Kofi & Cash Kiosk Haymarket Metro Concourse, Newcastle, UK

4.4 Study 1 – an observational approach

As actions and behaviours of individuals are a central aspect in this research, direct observation in real situations is of great advantage. An unobtrusive structured observational approach was used in this part of the study. Predetermined categories were used based on previous literature: density (Kaya & Erkip 1999), personal space (Hall 1969) and postural changes (Sundstrom 1975). This structured approach reduced ambiguity and any bias in recording the individual's behaviour. Also by noting actions and behaviours during the event this eliminated any problems associated with forgetting information and biased recall.

4.4.1 Observational recording sheet

An observational sheet was used to record details related to the participants sex, density, behaviour and distance from others while they queued or used the ATM, sex of person behind and the amount of time participants took to use the ATM (see Appendix A). Two interpersonal distance measurements were included which were distance from the ATM user and distance between participants in the queue. As the 'floor tiles' in the concourse measured 30cm in length this was thought an appropriate method to measure approximate interpersonal distance. Density conditions were determined by the amount of people, if any, waiting in the queue or using the Kofi kiosk: a zero was recorded if no other people were around when a participant was using the ATM, low density consisted of 1-2 people and high density 3 or more people.

4.4.2 Participants

Ninety-seven participants from Newcastle upon Tyne, UK were observed in this study, 51 males and 46 females. Participants were observed waiting to use or using an ATM at various Kofi kiosks on Metro concourses.

4.4.3 Procedure

Observations were made of each participant while they were queuing and/or using the ATM. The details of these observations were recorded on the observational sheet e.g. Density; Did the participant make any postural change while queuing? Interpersonal distance from ATM user - if they were next to use the ATM.

4.5 Observational results

For further analysis the observational data was split into two categories for the 45 participants who queued to use the ATM and for the 52 participants who did not queue.

4.5.1 No Queue Data

The 52 participants (24 male, 28 female) who did not queue to use the ATM 35 (18 male, 17 female) used the ATM at 0 density. Sixteen participants (6 male, 10 female) used the ATM at density 1 and 1 female used the ATM at density 2. Fifteen participants (5 male, 15 female) used the ATM when accompanied by others and only 1 female hid the ATM while using it even though density was 0. Eight participants made a purchase from the coffee stand (5 males, 3 females), these were alone. The mean time taken to use the ATM was 38.95 seconds (37.92 for males, 40 for females).

4.5.2 Queue Data

The 45 participants (27 males, 18 females) who queued to use the ATM 28 (17 males, 11 females) used the ATM at density 1, 17 participants (10 males, 7 females) used the ATM at density 2.

The observations for 'look around' and 'look behind' were collapsed into one for analysis. The frequency of participants who either looked around or behind when queuing in each of the density conditions is shown in Table 4.2. No significant difference was found between the amount of looking around or behind between the two density conditions $\chi^2(1, n= 90) = 2.879$, $p = 0.090$. This finding does not support the prediction that as social density increases participants will use more withdrawal behaviours such as looking around and/or behind compared to participants in low-density.

	DENSITY	
	1	**2**
Did not look	38	19
Did look	16	17

Table 4.2: Frequency of participants who either looked around or behind when queuing in each density condition.

The frequency of participants who made postural changes when queuing in each of the density conditions is shown in Table 4.3. The category 'postural changes' includes any changes in behaviour the participant made e.g. changing foot position or folding arms. A significant difference was found between density conditions and amount of postural change χ^2 (1, n=45) = 6.282, p <0.05. This finding does support the prediction that as social density increases participants will use more withdrawal behaviours such as making more postural changes compared to participants in low-density.

	DENSITY	
	1	**2**
Did not make change	19	5
Did make change	9	12

Table 4.3: Frequency of participants who made postural changes when queuing in each density condition.

Table 4.4 shows the mean distance (cm) each participant stood from the person in front of them in the queue for each density condition. No significant difference was found for queuing in each density conditions t (26) =1.56, p=0.13. This does not support the prediction that when social density increases the amount of personal space decreases between participants compared to participants in low social density conditions.

DENSITY	
1	**2**
68.25 (N=18)	61.82 (N=17)

Table4.4: Mean distance in cm between participants when queuing.

Table 4.5 shows the mean distance participants waiting to use the ATM stood from the ATM user for each of the density conditions. No significant difference was found for the distance utilised by participants waiting to use the ATM and distance from user for both density conditions t (36) = -0.22, p =0.83. This does not support the prediction that when social density increases the amount of personal space decreases between participants queuing and the ATM user compared to participants in low social density conditions. However, a significant difference was found between males and females in the amount of distance from the ATM user in low-density conditions t (15) = 2.42, $p<0.05$. Males did use more distance (mean 103.12cm) compared to females (91.4cm) this supports previous studies in that males use more distance dependent upon activity taking place compared to females.

DENSITY	
1	**2**
96.42 (N=28)	100.6 (N=17)

Table 4.5: Mean distance in cm between participants queuing and ATM user.

Analysis on the personal distance zone relating to either close or far distance for participants queuing revealed a significant difference in the amount of distance used $\chi^2(1, n= 36) = 28.4$, $p < .001$. Analysis on the personal distance zone relating to either close or far distance used by participants from the actual ATM user revealed a significant difference in the amount of distance used $\chi^2(1, n= 45) = 27.22$, $p < .001$. These findings show participants waiting to use the ATM increase distance from the actual ATM user, this helps maintain a certain level of privacy and comfort.

	QUEUE	ATM USER
close zone	34 (range 45-75cm)	5 (all 75cm)
far zone	2 (range 90-120cm)	40 (range 90-120cm)

Table 4.6: Amount of participants when queuing or from the ATM user within the two phases of the personal zone.

Note that 9 participants did not have anyone behind therefore were not included in data

Table 4.7 shows the mean time (seconds) taken to use the ATM for both density conditions. No significant difference was found for the time taken to use the ATM in both density conditions $t\ (36) = 0.45$, $p = 0.65$. This does not support the prediction that participants would use the ATM faster when social density increases.

DENSITY	
1	**2**
44.92 (N=28)	42.00 (N=17)

Table 4.7: Mean time in seconds taken to use ATM in each density condition.

As frequencies were too low for some categories related to densities 1 and 2 no statistical analysis could be made. However the following observations were recorded:

- None of the 45 participants made any verbal response to either the ATM user or anyone else in the queue.
- Only 3 females hid the ATM when using it: 2 in low-density (1) and 1 in high-density (2).
- Out of 45 participants 2 males and 2 females made a purchase from the Kofi stand all in the high-density condition.
- In the low-density (1), 25 participants were alone and 3 participants were with others while queuing and using the ATM. In the high-density condition (2), 15 participants were alone and 2 were with others when queuing or using the ATM.

4.5.3 Summary of observational findings

- As density increases individuals display certain withdrawal behaviours i.e. more postural changes
- Males use more distance in low density conditions compared to females
- Individuals utilise the close and far distance of the personal space zone dependent upon the activity taking place

4.5.4 The observational debate

The observational study produced some interesting findings. A significant difference was found in the amount of postural changes made when queuing between the two density conditions. Participants who queued in the high-density condition made more postural changes compared to participants who queued in the low-density condition. A significant difference was found between the close and far phases of the personal distance zone when queuing. Participants used the close phase of the zone for queuing and the far phase of the zone for distance from ATM user.

The findings support previous research such as Kaya & Erkip (1999) in that people prefer to use various distances depending on the activity-taking place. This study found participants tend to utilise their personal space dependent on the type of activity taking place i.e. the two different phases of Hall's (1969) personal zone in both high and low density conditions. The close phase of this zone was used when participants were waiting in a queue; participants who were next to use the ATM used the far phase to create more distance from the actual ATM user. Therefore, the amount of space utilised describes and communicates to others the level an individual requires for privacy and freedom from others observation.

When desired levels of privacy and personal space are not met people begin to feel uncomfortable and make behavioural adjustments to compensate. Participants in this study when queuing in high-density conditions made more postural changes than participants who queued in low-density conditions. This supports previous research by Sundstrom (1975). Making more postural changes while waiting could also be associated with restfulness tension and anxiety, as people tend to dwell on negative thoughts e.g. being late for next task (Bennett 1998); lack control or are forced into close physical proximity with non-favoured others (Baron & Rodin 1978).

4.6 Developing a questionnaire

Advantages and disadvantages of using questionnaires were discussed in chapter 2. To develop a reliable and valid psychometric tool a pilot study is an important part of the process as the one described in this chapter. The questionnaire developed in this study was based on existing theoretical frameworks such as TAM and the privacy types proposed by Pedersen. As Dabholkar (1996) stated researchers continue to be interested in how attitude towards technology influences use. Therefore when trying to understand individual's attitudes and intentions to use technological systems in public areas it is very important to develop reliable and valid tools to assess such a phenomena.

The questionnaire used in this study incorporated a Likert scale. Coolican (1994) suggested three advantages of this scale:

- Individuals prefer Likert scales as they are considered 'more natural' to complete and maintain direct involvement
- They are high in reliability and validity
- Effective in measuring changes over time

4.6.1 Study 2 – questionnaire development

The newly developed survey consisted of questions related to participants' opinions on several issues: privacy, personal space, security, experience, awareness of others, ease of use, usefulness and future use (see Appendix A). Demographic characteristics (age, sex) were also recorded. Questions were developed from previous research by Pedersen (1999), Kaya & Erkip (1999), Demirbas & Demirkan (2000), Altman (1975). Questions were counter balanced and questions 2, 4,6,14,19,20,24,27,33,and 34 were reversed for scoring to avoid order effects and increase reliability. The questions are listed below in their respective categories:

SPECIFIC PRIVACY-1 (privacy issues with regard to this particular ATM):

- How sure are you that other people could not see how much cash you withdrew?
- How sure are you that other people could not see the ATM screen or keys when you were using it?
- How sure are you that other people could not see the transaction you carried out?
- Do you think other people could see any of your personal information when you used the ATM?

GENERAL PRIVACY-2 (privacy issues with regard to general ATM use):

- Did you feel you had enough privacy when using the ATM?

- Do you prefer to use an ATM away from crowds?
- How would you feel if a stranger started talking to you when you were using the ATM?
- Would being recognised when using an ATM bother you at all?
- Does being observed by others disturb you?
- Would you be willing to let a stranger help you use the ATM if you did not know how to carry out the task yourself?

USEFULNESS:

- How much preference do you have for using this particular ATM compared to others?
- How satisfied are you at the services this ATM provides?
- How useful to you is this ATM?

SECURITY:

- How safe/secure does the location of this ATM seem?
- Do you think there is any risk if using this ATM on a dark evening?
- Do you feel there is any risk involved in using an ATM?
- How much money would you feel safe withdrawing from an ATM?

ANXIETY:

- Did you feel at all anxious while using the ATM?
- Did you feel at ease while standing in the queue?
- When you were using the ATM did you feel at all uneasy?

SPACE:

- Do you feel the amount of space around the ATM is sufficient when queuing?
- Do you feel the amount of space around the ATM is sufficient when using it?
- Would you prefer an enclosed area while carrying out personal transactions?

EASE OF USE:

- How would you rate this ATM for ease of use?
- Did you have any problems when using the ATM?

AWARENESS:

- Were you aware of how long the person in front of you took to use the ATM?
- How aware are you of others around you when using the ATM?
- How aware were you of the sex of the person behind you in the queue?

EXPERIENCE:

- How many times did you use this ATM last week?
- How would you rate as your current skill in using computers/IT?
- How easily do you accept changes in technology?
- How quickly do you use new technology?

FUTURE USE:

- Would you feel at ease using an ATM for personal information e.g. loan requests, deposits in such areas as:
    i. A railway station
    ii. A leisure centre
    iii. A garage
    iv. Your local High Street
    v. A bank foyer
- How much, if any, do you think people's privacy is threatened by recent/future changes in technology?
- How would you feel about using an ATM in your local store?
- Would you feel uneasy about receiving details about your account on your mobile telephone?

4.6.2 Participants

Participants were recruited through opportunity sampling. Fifty-seven participants out of the total observed in study 1 completed the questionnaire, 30 males and 27 females. The age range of the participants who completed the questionnaire was from 17 to 67 years (mean 31.72).

4.6.3 Procedure

After the participant had used the ATM they were approached and asked to complete the questionnaire. Forty participants refused. Participants were briefed about the nature of the study and instructed how to complete the self report questionnaire. Completion took approximately 5 minutes. Participants recorded their answers on a Likert scale that ranged from 1-7 or circled not applicable –N/A if the question did not relate to them e.g. Do you think other people could see how much cash you withdrew? After completing the questionnaire all participants were debriefed and thanked.

4.6.3.1 Testing for reliability

Prior to further analysis all variables were examined through various SPSS programs for accuracy of data entry, missing values, fit between their distributions and the assumptions of multivariate analyses. Missing values for questions 26 and 28 on awareness and question 19 for anxiety resulted in 30 values replaced by the overall mean. Normally these cases would be deleted from the analysis however, due to the nature of the questions and the exploratory nature of the study, a decision was made to use the mean and retain the questions in the analysis.

To check reliability t tests were used to compare the raw scores from each of the forty questions for participants with the highest 19 and lowest 19 scores from all questions. The majority of questions were found to be reliable measures at either the .01 or .05 level of significance. The following questions were not found significant: Ease of use (*Did you have any problems when using the ATM?*), Space (*Would you prefer an enclosed area while carrying out personal transactions?*) and were therefore dropped from further analysis. This may have been related to ambiguity with the wording of the questions related to space and ease of use.

When tested for internal consistency, the subscales produced coefficient alphas ranging from .51 to .87, mean alpha = .73 (reliability outputs can be found in Appendix A). The alpha coefficients related to each subscale were: privacy 1 (.7869), privacy 2 (.6289), space (.8388), security (.7666), ease of use (.7278), usefulness (.5564), awareness (.8214), anxiety (.8685), experience (.8089) and future use (.5083).

Construct	Alpha	Mean response	Sd.
Privacy 1	.7869	4.17	1.70
Privacy 2	.6289	4.06	1.94
Space	.8388	5.09	1.56
Security	.7666	3.45	1.82
Ease of Use	.7278	6.15	1.48
Usefulness	.5564	5.36	1.62
Experience	.8089	4.45	1.54
Anxiety	.8685	5.13	1.69
Awareness	.8214	4.53	2.14
Future use	.5083	4.23	1.75

Table 4.8: Alpha coefficients, means and standard deviations for the each of the subscales used in the questionnaire

4.7 Questionnaire results

A stepwise regression was performed between future use of ATMs as the dependent variable and privacy 1 (specific privacy related to this ATM) privacy 2 (general ATM privacy issues), security, awareness, experience, space, anxiety, ease of use and usefulness as the independent variables (details of the regression analysis can be found in Appendix A).

The analysis explained 62.6% of the total variance. Results of the analysis show four of the independent variables contributed significantly to the prediction of future use of ATMs privacy 2 (general), experience, anxiety and privacy 1 (this ATM), $F(4,52) = 21.78$, $p < .001$. However, failure of security and space to appear in the output was clearly due to the high correlations with privacy 2, anxiety and experience. Table 4.9 shows the output of the stepwise regression for the various independent variables on future use.

	Future DV	Priv.1	Priv.2	Secur.	Aware	Exper	Space	Anx.	Ease	Useful	B	β	sr^2
Priv.1	.240										.155*	.184	.03
Priv.2	.684	.078									.283**	.328	.06
Secur.	.656	.251	.728									.161	
Aware	.128	.382	.139	.068								-.015	
Exper.	.619	.102	.584	.497	.084						.285**	.306	.06
Space	.646	.194	.650	.60	.093	.571						.113	
Anx.	.582	-.003	.564	.533	-.005	.356	.604				.203**	.288	.06
Ease	.214	.142	.049	.117	.308	.173	.252	.171				.076	
Useful	.313	.175	.208	.197	.341	.345	.478	.224	.367			.049	
Mean	4.23	4.13	3.90	3.45	4.62	4.45	5.02	5.37	6.15	5.36			
Sd.	1.15	1.36	1.33	1.40	1.11	1.23	1.41	1.62	1.32	1.22		$R^2 = .626^a$	
											Adjusted	$R^2 = .598$	
												$R = .791$	

** $p < .01$
* $p < .05$

[a]Unique variability = .21;
shared variability = ..42

Table 4.9: Stepwise regression for the various independent variables on future use of ATM's as the dependent variable.

4.7.1 Summary of questionnaire results

- Both general and specific privacy, anxiety and experience influence future use of an ATM
- Space and security are highly correlated with general privacy, anxiety and experience, therefore results should be treated with caution
- Highlights external variables have a direct effect on use of an ATM that need to be considered in future research

4.7.2 Examining the findings from the questionnaire

The regression analysis produced four variables that were significant in predicting future use of ATMs: privacy both general and specific types, anxiety and experience. Although the study did explain 62.6% of the variance other important factors are also involved that influence future use, therefore, it would be inappropriate to draw definite conclusions at this exploratory stage.

Privacy does appear to be a major determinant and predictor of ATM use, along with experience and levels of anxiety. However, discriminant validity is low as the degree of overlap between variables e.g. privacy 2 (general privacy issues) and security is high. The overlap does suggest the existing high correlations between variables may be measuring the same factor. For example, in relation to ATM use it is possible that privacy and space may both relate to security issues due to the nature of the activity. The questions for both privacy categories were developed from previous research (Pedersen 1999; Demirbas & Demirkan 2000) and warrant further consideration. Pedersen classified six types of privacy four of which have been used in this study: solitude (freedom from others observations), reserve (not revealing through verbal disclosure any personal information to others), isolation (being geographically removed and free from observation by others) and anonymity (being seen but not identified or identifiable by others).

The questions for privacy issues that related to 'this particular ATM' were based on Pedersen's (1999) type of privacy categorised as 'solitude'. The analysis revealed that privacy relating to use of 'this particular ATM' was a significant predictor of future use this also implies that 'solitude' as a type of privacy is an important concept within that category as it is related to freedom from observation by others. The questions for privacy issues that related to ATM use in general were a combination of the four of Pedersen's types of privacy. However the analysis revealed this category was a significantly greater predictor of future use of ATMs than the first privacy category; this questions the distinction between all of the types of privacy proposed by Pedersen. Previous research by Demirbas & Demirkan classified questions such as 'I prefer being alone, instead of being in a crowd in the studio' as 'reserve' however Pedersen states that reserve is connected to verbal disclosure of personal information. They also suggest 'I want some partitioned spaces to exist for private study in the studio' as 'isolation' Pedersen suggests that 'isolation' is being geographically removed from others observation. The privacy model proposed by Pedersen needs to be more clearly defined as solitude and isolation overlap; there is no distinction on the amount of distance required between people to classify them into either type of privacy. Reserve and anonymity as types of privacy also overlap, again no clear distinction seems to exist especially when the model is used for different research purposes. A level of confusion is apparent when applying Pedersen's model to issues on privacy in particular to different areas of research, a new model with distinct categories needs to be developed that can be applied to all areas without any overlap or confusion.

Concepts such as ease of use and usefulness, which have been found in all research with TAM (see Davis 1989; Igbaria & Iivari 1995), were not significant in predicting future ATM use. TAM suggests that all outlying factors are channelled through perceived ease of use and usefulness, however this study does reveal the importance of other external variables on use and the mechanisms that determine user behaviour are more complex than stated in the model. Korukonda (2004) also questions how the concept 'external variables' in TAM that is purported to include personality, cognition and socio-structural variables can be collapsed into a single category with such diverse variables. This thesis supports this view.

Interestingly anxiety appeared as a significant predictor of future use. Participants in this study rated feeling more at ease when using the ATM and less at ease when queuing. Anxiety can be split into two categories: trait-based (personality tendencies which are stable over time and situation) and state anxiety (a response to a situation). According to Igbaria & Iivari (1995) computer anxiety is a form of state anxiety that results in an individual suffering from 'irrational emotional distress' when contemplating the use of IT systems. Computer anxiety has also been determined as a key variable related to perceived ease of use and usage (Gilroy & Desai 1986). As participants in this study rated themselves as experienced IT users it seems unlikely that any feelings of unease when queuing could be classified as computer anxiety. Perhaps the type of unease participants felt when queuing relates to the type of activity taking place and therefore a response to a situation (state anxiety). Feelings of unease when queuing need further investigation.

Other interesting responses from the questionnaire revealed that overall participants in this study rated themselves as experienced IT users who accept changes in technology easily and use new technology quickly. They rated the ATM easy to use and useful. Also the amount of space available around the ATM was sufficient for queuing and for using the ATM. Participants rated 'feeling more at ease' using an ATM in the future in their local store, bank foyer and leisure centre compared to feeling less at ease using an ATM at a railway station, a garage and their local high street. Another favourable outcome was that participants rated feeling at ease with receiving personal information on their mobile phone, however an overall lower response was recorded for 'How much, if any, do you think people's privacy is threatened by recent/future changes in technology?' Comparison of the two responses is quite interesting as perhaps participants in this study see receiving personal details on their mobile as no threat to their privacy as the phone belongs to them. However when generalising to the population they see changes in technology as more of a global threat to privacy, this warrants further investigation.

Kaya & Erkip (1999) suggest that using an ATM is the type of activity that requires the transaction to be carried out in a very short time period. If a person requires help from someone this further annoys people waiting in the queue causing them to decrease interpersonal distance or actually leave. Although this study did not measure this phenomenon, interestingly the question, which related to 'help from others if needed', produced an overall lower response. Suggesting invasion of both personal space and privacy results in feeling of discomfort when using an ATM , even if help is needed at that particular time.

Participants also perceived there to be a high risk involved when using this particular ATM on a dark evening although it is located in a well lit busy concourse and perceive there to be a risk in general when using ATMs. Participants rated that the amount of cash they would feel safe withdrawing from an ATM was between £55-£100.

4.8 Addressing limitations

Although the research was exploratory various limitations need to be addressed. The questionnaire was constructed by using existing questions from other research areas not linked to ATM use or external environments in general. The actual structure of the questions may have led to a great deal of ambiguity. Comparison of existing ATMs in 'holes in the wall' and ATMs in new locations may have uncovered different issues with regard to use. The results maybe an artefact of the small sample size, in order to generalise the results to the general population more participants are required in future studies. Further analysis of the data could have compared participant's responses on the questionnaire to density levels to see if higher levels of anxiety existed in the higher density condition. The actual density levels could be improved upon by taking into account higher levels e.g. more than 6+ people queuing or around the ATM if this is possible. Variables that have been discussed in previous chapters were not measured in this study e.g. irritability associated with queuing. Therefore a comprehensive qualitative approach would be advantageous at this stage. Interviews with users of ATMs may highlight issues or concerns that have not been considered in this investigation.

4.9 Discussion

Although this study was exploratory findings have revealed people's subjective feelings of privacy, comfort and experience play a major role when using an ATM in a public zone. Three challenges were set out in the introduction:

- To combine previous findings from the HCI and psychological literature to try to begin to understand human interaction with technology in public places
- To explore and evaluate TAM in relation to how external variables influence use
- To find what factors affect use of public space technologies, in this case an ATM

These challenges have been successful. Firstly, in combining previous findings from the HCI and psychological literature. Secondly, findings from this study show external variables need to be considered when trying to understand the use of technology in public places. TAM needs to be expanded to account for social influence. Socio-environmental variables have a direct effect on attitude towards future ATM use. The third challenge was to find the factors that influence use of technology in public places. Although the findings from this study need to be treated with caution, it was exploratory. Results have provided preliminary evidence that variables such as privacy need further exploration as they appear important when considering technology use in public areas.

4.10 Chapter Summary

As technological systems in public zones are now on the increase there exists a need to further understand individual's perception and behaviour on use. Kaya & Erkip (1999) suggest a few innovative ideas in designing areas around ATMs e.g. a line on the floor, installation of a turnstile to stop people encroaching into one's personal space, however with regard to the new locations of ATMs e.g. inside a local store, these ideas are not practical. The need is to find the factors that make people feel comfortable and use ATMs especially for accessing cash and information in new locations as well as old. For some people accepting new or changes in technology is difficult but by positively influencing user perception and beliefs regarding the benefits and usefulness people may become less resistant in future use.

Chapter 5

The user at the heart of the research agenda

This chapter describes a qualitative study using data derived from interviews with actual ATM users. A grounded theory approach was used as this is preferable in exploratory research where the aim is to understand a process or phenomenon (Strauss & Corbin 1990). The study has provided empirical evidence of several personal and non-personal constructs that influence attitude to ATM use. The interviews illustrate how attitude towards use is affected by personal concepts: space, time pressure, privacy, safety and non-personal concepts: ease of use, location, usefulness. A conceptual model of ATM use was developed from the themes and concepts that emerged from the data.

5 Introduction

The exploratory study reported in chapter 4 began the investigation into factors that influence use of technology in public areas. The study examined people's attitudes towards use of an ATM and their subjective feeling of privacy and comfort. Findings showed in high-density conditions people made more postural changes when queuing compared to people queuing in low-density conditions. Also people increase distance to maintain a certain level of privacy for the actual user of the ATM. Therefore the amount of space utilised describes and communicates to others the levels an individual requires for privacy and freedom from others observation. Levels of privacy, anxiety and experience were also found to be major determinants that affected ATM use. The research also highlighted other factors (space and security) also impact upon use of ATMs. These findings suggest the need for further investigation into ATM use in public zones.

The results from the previous study are evidence that human interaction with technology in public areas is complex. Findings highlight factors such as perceived levels of privacy and anxiety affect attitude towards use of an ATM. To begin to fully understand this complexity a more in-depth approach is needed, an approach that puts the user at the heart of the research agenda. One method that can yield a rich source of data and give insight into any problems or issues related to the area of interest is interviewing actual users. Interviews may uncover why, what and how external variables affect use. For example what makes some users more anxious when using an ATM compared to others?

5.1 A note on the methodology

The qualitative study reported in this chapter used a grounded theory approach. The data was obtained from interviews with users of ATMs. A qualitative approach in particular the use of interviews is appropriate when quantitative research might later be generated from the findings. Glaser & Strauss (1967) argued the primary goal of qualitative research is to generate a theory rather than test an existing one or provide a simple description. They postulate the use of qualitative methodology can better our understanding of any phenomenon about which little is yet known or understood. It can also give new perspectives or more information with regard to existing knowledge.

5.1.1 Participants

A total of fifteen participants took part in the study, 6 males and 9 females using purposive (theoretical) sampling. The age range was from 21 to 69 years (mean 41.4 years). Participants were recruited from the general population in the Newcastle upon Tyne area of England. Participants stated they were either current users or had used ATMs in the past; therefore this resulted in a range of responses towards use by including both frequent/non-frequents users.

5.1.2 Procedure

All participants were interviewed individually using an open ended semi-structured technique in their own home. All interviews were tape recorded with prior consent of the participant. Participants were given a brief introduction to the area and asked about their views and any issues related to ATM use, '*I am undertaking research into ATM use. I am interested in your views, feelings, opinions and any other issues that you feel are important to you when using an ATM and may actually affect your use*'. Although the interviews were semi-structured and all participants talked freely about their opinions/experiences only two direct questions were asked:

1. *Have you used ATMs in different locations?*
2. *What do you think of using ATMs for accessing different types of information e.g. holiday details?*

An interview guide was used to prompt participants if they began to discuss irrelevant information or refer them back to a previous point they had made. For example prompts that were used included: *Why did you say that? I'm interested in your reasons for saying that.* The duration of the interviews varied from 20 to approximately 50 minutes.

5.1.3 Grounded Theory

Grounded theory is preferable in exploratory research where the aim is to understand a process or phenomenon (Strauss & Corbin 1990). The aim of grounded theory is to generate a theory by highlighting the underlying processes, structures and mechanisms of the phenomenon under study. A theory emerges from the interaction between the concepts and categories found in the data. An important issue in the grounded theory approach is that no preconceptions of the phenomenon exist; therefore themes and ideas that emerge from the data are valid concepts.

The central process in grounded theory is to break down the data that has been obtained from the research, conceptualise it, reassemble the data and then construct a theory. This process involves finding the conceptual categories within the data, finding relationships between them and then account for relationships through core categories (Robson 2002). In grounded theory three basic types of coding are used to analyse the data:

- Open coding – notes or transcripts are divided into discrete parts (e.g. sentence or paragraph)
- Axial coding – categories from the open coding stage are linked together
- Selective coding – creation of a set of propositions that connect coding and categories

The main purpose of coding is to begin to acquire a new understanding of the research area being investigated. Firstly the data is open-coded to identify concepts, and then by using axial coding the concepts or categories are connected to each other. Glaser

(1992) suggests in the axial stage of coding categories should emerge from the data without being forced into any pre-determined format. Selective coding is then used to create a visual model that connects concepts and categories; if grounded theory has been carried out correctly then the final result will be a set of theoretical propositions. Overlap between concepts or categories between coding types is common.

5.2 Analysis

All interviews were transcribed then read; a sentence-by-sentence analysis was employed. The data was then open coded using grounded theory techniques and several categories were identified. The data was physically grouped into categories using sentences and phrases from the interviews. Categories were then grouped into the different concepts, themes and ideas that emerged during the analysis. The concepts were then compared using axial coding to build a conceptual model of ATM use.

The various themes and concepts that emerged from the analysis provided greater insight into the issues regarding attitude towards ATM use. The analysis revealed several constructs that influence the use of an ATM in a public area. Four personal constructs emerged towards use: space, privacy, safety and time pressure. Time pressure was found to have a direct link to the construct space. Three non-personal constructs emerged towards use: ease of use, location and usefulness of an ATM. All constructs were found to have either a direct and/or indirect affect on attitude towards use.

5.3 Model of use

The analysis of the data discovered inter-relationships between personal and non-personal constructs from which a conceptual model of use emerged (see Figure 5.1). The proposed model considers the influence these constructs have on attitude to ATM use which can result in use or non-use.

The model postulates that constructs both personal (space, time pressure, privacy and safety) and non-personal (ease of use, usefulness and location) all have a direct or indirect affect on attitude to use. Thus a person's attitude will either result in use or non-use of an ATM.

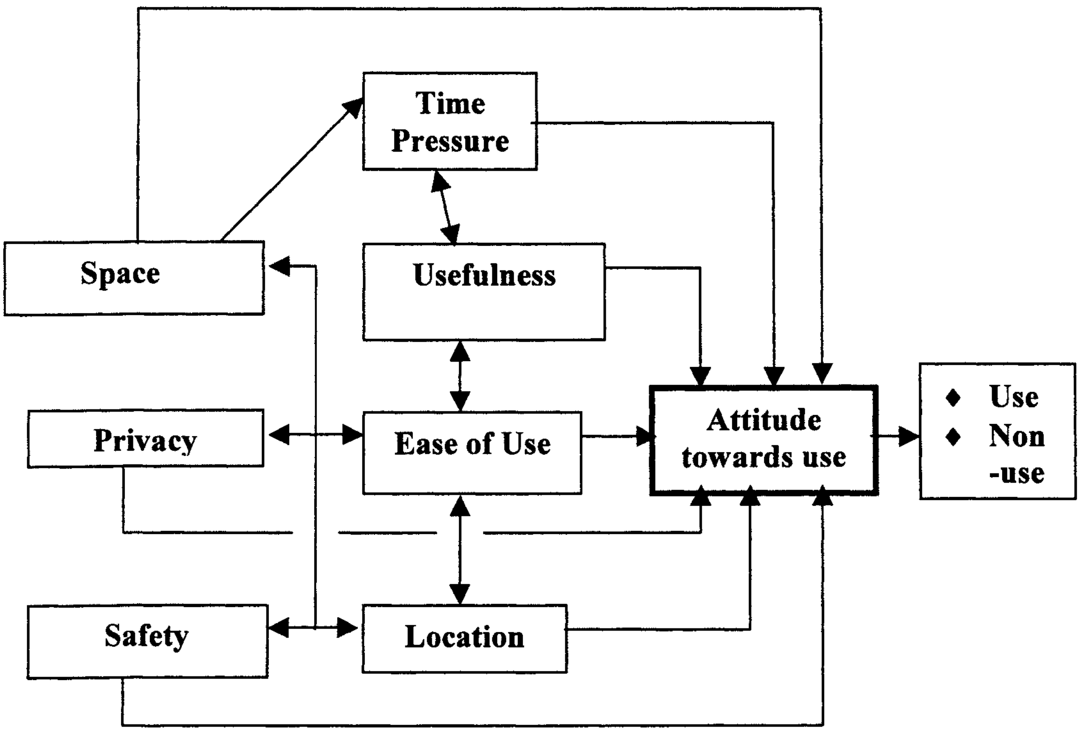

Figure 5.1: Conceptual model of use or non-use of an ATM.

5.3.1 Personal Constructs

The concept of space relates to the amount of people around at the time someone is either using or waiting to use an ATM. This includes issues related to crowding, queuing and personal space. The concept of time pressure results from queuing (space) and has a negative affect upon use. Privacy relates to not being observed or revealing personal information to others and having adequate amount of personal space when using the ATM. Safety issues when using an ATM are associated to the risk of crime.

5.3.2 Non-personal constructs:

The concept of ease of use is associated with how easy the system is to use, the layout and the immediate space around the ATM. Location relates to the area the ATM is in e.g. in street, attached to supermarket, convenience. Usefulness refers to convenience, use of an ATM as a financial and/or information system.

The proposed model of ATM use or non-use supports previous research such as TAM (Davis 1989) in that attitudes are a major determinant and predictor of use of a technological system. TAM postulates that attitude towards use is a function of two beliefs: perceived usefulness and ease of use that can be or is influenced by external factors. All outlying factors in TAM are channelled through perceived usefulness and perceived ease of use. The findings in this study suggest that two of the core constructs ease of use and usefulness are similar to those proposed by TAM. However, unlike TAM all of the external factors found in this study (space, time pressure, privacy, safety, usefulness, location and ease of use) have a direct and/or indirect affect on attitude towards use. Hence, when using a technological system in a public area such as an ATM, this study posits that attitude to use is a function of personal (space, privacy, safety and time pressure) and non-personal constructs (ease of use, usefulness and location).

The concepts refer to:

- Space – the ability to manipulate, protect, control, communicate and regulate the level of interaction with others through the use of space
- Privacy – the ability to control how much if any information other people may see. Also to maintain a desired level of privacy for how much or how little an individual wants to interact with others
- Safety – refers to features of the actual environment such as the actual location, time of day, other people around that increase or decrease perceptions of safety
- Time Pressure – the individuals perception of time pressure from other people who may be waiting to use the machine
- Ease of use – refers to design aspects of the machine and the perception that it is easy to use
- Usefulness – refers to what the system can be used for
- Location – refers to the actual location and the convenience of the machine

5.4 Personal factors

5.4.1 Space

A major issue that emerged from all of the interviews was that of space and its effects on use. From the responses it became apparent that a non-monotonic relationship exists with space when connected to ATM use. When there is too much space the area around the ATM is classed as 'too open' this results in concerns over being observed by others and safety issues. This can be seen in the following statement:

"I think any problems comes from your anxiety, if you're using machines and say it's after work hours and it's not so busy, people are off doing other things, they're not milling around as normal, so obviously there's not many people about and you could be observed by somebody".

When space is limited this also results in negative effects on use and the user. For example, in high-density situations there was an overall consensus of crowding which results in reduced personal space/levels of privacy and an increase in safety issues. Although high social density was related to how many other people are seemingly around at that time the main concerns came from other people queuing:

"I don't like to queue, especially as when you queue the queue moves closer to the person using the machine, well it feels like that, so when it's my turn I feel as if the queue is right behind me, you know what I mean as if it's part of you".

Generally comments were made that if 3 or more people were already queuing to use an ATM then they personally wouldn't wait due to the above issues of reduced personal space and levels of privacy.

5.4.2 Time pressure

The issue of time emerged not only as a personal issue *" I wouldn't wait due to the time it (the queue) would take to go down"* but also as a perceived pressure from other people waiting. Time pressure from others became apparent as a major negative effect of queues, not only does the ATM user feel as if they have to hurry, but it also stops them carrying out several transactions on the ATM:

" Maybe there's some things I want to do like check my balance, check whatever and even transfer money, you can do that on an ATM from one account to another you don't think you've got enough time to do it 'cos there's a queue and you think you have to get your money and run".

"If you've got people standing behind you feel panicky, thinking Oh God I'm holding the queue up and nine times out of ten you'll only do one transaction where you wanted to do two".

5.4.3 Privacy

Privacy emerged as a major concern when using an ATM with lack of privacy inhibiting use. Participants commented on the fact they sensed other people watched them or came too close when they used an ATM. This resulted in feelings of intimidation and lack of trust or respect, as using an ATM it is not only a private interaction but includes dealing with very personal information:

"Some people don't stand back enough, you know, they don't give you enough room, as if they're nosy and want to see what you're doing. Also you don't know who they are, they could be robbers or anything, you just don't know. I don't want people to see what I'm doing, or how much money I've got out or even my balance. I don't look at other people when they're using it, well any financial information is personal and you want to keep that sort of stuff to yourself, not let anyone else see it".

"*...more and more kids are getting cards and so you find yourself queuing more and more often with kids behind you and they don't respect your privacy".*

"I feel intimidated by other people watching me, I don't know why I just do and I feel you can sense that yourself when you're waiting to use the machine. That you know, people are standing over you and that makes you feel nervous".

Some of the participant's in particular female respondents stated that they adopt certain behaviours to hide what they are doing and increase feelings of privacy and safety when using an ATM:

" *When I use them, as I'm only small, I try to make myself seem bigger, you know like this (expands arms out) that's so I feel safer and people can't see what I'm doing. I don't know whether it works but I still do it".*

5.4.4 Safety

Major concerns emerged over safety and crime issues related to ATM use. Participants perceive a risk of crime when they use an ATM particularly at night or in certain types of locations. Comments that were made about safety revealed participants felt vulnerable, nervous, risked being targeted after withdrawing cash and concern over how many people were around. Reference was made by a few to the fact they always assessed the area and location before use *"I always have a good look around before I go up to one and use it"*. The location of the ATM also generated concern, the type of area, an open street, time of day and the amount of space available all influenced use. The following comments were made about these issues:

"I think I tend to use them at supermarkets, there's lots of people around, you feel quite safe".

" There are certain places where they have cash machines that are perhaps out of hours, they're a bit isolated and I sometimes feel a bit scared then".

Another factor that adds to safety concerns is other people's behaviour near the ATM:

" Anyway, there was a man using the machine and he looked dodgy, he had a hat pulled right down nearly covering his face and he kept looking around all the time when he was using it, he seemed like a right one".

In the above case the man's behaviour made this participant very aware of the situation, as she explained further the man in question turned out to be quite a famous footballer and was probably trying not to be recognised!

Many concerns over safety related to personal identification numbers (PINs), specifically that other people could see them when entering it into the ATM and forgetting the number altogether.

"..there could be someone standing and you could put the receipt in your purse, they could have watched you with your PIN and could follow you, pinch your purse, whip your card, know your PIN then just go use it".

"I think there is always a question of when you put in your PIN. Perhaps it's the little keypad it's obvious (that people can see PIN) to people standing in a queue and if you were good at numbers you would probably know they put in one, two, three, four, you could perhaps work that out if it were possible".

5.5 Non-personal concepts

5.5.1 Ease of use

The actual design of the ATM influences use and several issues arose from a lack of space to not being able to read the screen due to glare from the sun. Participants suggested that certain designs of ATMs decreased feelings of privacy, personal space and safety:

'I would like a flat surface, usually on these places you have a sloping surface, it would be nice to have a flat surface to put your wallet or handbag'.

'I think they should be in psychedelic colours to make them stand out more'.

'So I think the system of where you put your card in and it asks you what transaction you want but if you ask for money first you've got to put your card in for a second time to get a balance. I think they should so that the opposite way where when you've finished you should actually get, so that you're remembering to pick everything up and then your card would be your last thing that you would pick up in sequence'.

'Also there's like four buttons on either side and five options on either side so you think which button do I press..'

Many comments were made on how the design of the ATM and the area around the ATM could be improved e.g. a line on the ground for people to stand behind while waiting to use the ATM or a booth/shield to increase levels of privacy, personal space and safety. However although participants suggested the installation of booths/kiosks the implications were that ATMs should not be located in too much of an enclosed area as that would increase the risk of crime.

'I think there should be like a sort of telephone booth or walk-in area that'll separate you from a person, even if they made something like that. Obviously you don't want to be sheltered in for muggings, you don't want to feel cornered in somewhere secluded but if they made it a bit more private".

Other comments suggested that ATMs should remind you to take your receipt, have an arrow on the actual card, improved lighting around ATMs, don't place two or more machines together or near a window, made more colourful and more accessible for partially sighted people. One comment suggested voice activated ATMs. The following statements make reference to these issues:

'I think they should remind people to take their receipts with them, wait for your receipt, destroy it, don't leave them lying around'.

" ...what they could do from a psychological thing is put a line on the pavement somehow, at a certain distance away then people might start to register that they have to stand behind that line when someone else is at the machine. It's like being at passport control at the airport, you go up to the custom's officer but the next person behind you is always standing behind a line, so it gives you enough space".

"It's as though there should be a screen up that people can't see through and see what you're doing".

"Why don't they have talking machines that say 'Good morning, something like this so they know who you are and it it's a nice voice, if it's a friendly voice you might feel 'ah that sounds alright – you know what I mean".

5.5.2 Location

The different areas ATMs are located also effects use. A major factor of ATM use is convenience for example when they are attached to nearby supermarkets or in areas where people work. However some locations particularly interior ones are preferable to others due to increased feelings of safety, personal space and privacy. ATMs that are located in department stores, shopping complexes, bank foyers etc. are preferred and perceived as safer, more private and have more space than ATMs found in streets. ATMs in streets are described as 'too open' and in particular using an ATM at night appears to increase anxiety. Although all participants were aware ATMs had to be located in streets for the 24-hour banking facility. ATMs that are located in areas such as shopping complexes are perceived as having more 'normal' people milling around so the user feels safer. Participants gave negative responses to using ATMs in small local stores, although they were classed as convenient and safer, many thought the charges were too much, were less private and lacked space. The following responses reflect on these issues:

"Now obviously if I were in town and working and doing something I would just use the nearest which is more likely to be a bank one".

"Thinking about it one of the first considerations is where it is (the ATM) and how comfortable you feel about it".

"The only thing that makes me feel uncomfortable is the surroundings so obviously location means a lot where they actually are (the ATM), the area, the type of people who are around you".

"My favourite location, believe it or not, is to go into the bank and use the interior machine 'cos that's where I feel safest".

One participant preferred to use an ATM at a garage and another discussed the convenience of supermarket ATMs:

"I use them a lot at garages as, especially at garages, you can kill two birds with one stone, get your petrol and use the machine they're good for that. It's easier more convenient as you pull up and use them".

"I use the one at Safeway (supermarket) a lot, because that's where I shop and it's handy. I use them in the Metro Centre (shopping complex) because I work there, the ones' (ATM's) in the Metro Centre are good because I feel safer as there's lots of people around, not like some in town (Newcastle City) where you feel you're out on the street in the open".

Other suggestions were that ATMs should not be located where traffic congestion and accidents can occur e.g. near double yellow lines as people become thoughtless and park their cars there while using them. Although ATMs inside banks were rated as safer to use they were rated as less convenient than other locations due to the fact that people generally have to park their cars and walk into the bank. Participants suggested that ATMs in 'dubious' areas resulted in less use, feeling uncomfortable and a higher risk of crime exists.

5.5.3 Usefulness

The usefulness of the system refers to the type of activity that an ATM can or could be used for. ATMs are perceived as machines used only for cash withdrawal or checking balances. When asked opinions on using an ATM as an 'information system' participant's responded with very negative attitudes. Their main concerns were that it would increase queues and the negative effects associated with queuing: The following statements encompass this:

"No chance, you have to be quick, they're for getting money out, checking your balance, not for checking other stuff, that's silly. Imagine what you would feel like waiting in a queue to get money and someone taking ages checking holidays or other stuff. No, no I wouldn't use them for that, just getting money out. That's a daft idea".

"I would get agitated if someone was using a cash machine for something else".

5.6 Attitude to use

Attitude towards use of an ATM is influenced by both personal and non-personal constructs e.g. perceived levels of privacy, usefulness of the system. All constructs have an effect on use and this is reflected in the participant's general attitudes. Participants described ATMs as convenient and a fast way of getting cash or an account balance. However, negative influences from situational factors (personal and non-personal) in the environment can result in non-use. For example, several participants stated if the area around the ATM was crowded they would tend not to use the machine due to reduced levels of privacy and safety.

When a desired level of comfort is not attained this can result in negative emotional states such as feelings of vulnerability, intimidation, pressure, anxiety and even fear of ATM use. Although some participants stated non-use of ATMs was due to preference for certain other factors such as using the cash back facility in shops, opting to use the bank counter for safety and a human face. The following statements reflect these issues:

"...but as they are I find them a little bit intimidating and I would rather use a cheque or go to the counter".

" The good thing about them is I do like to get my balance, now that is a good thing and just get a print out, now that doesn't bother me at all, I do use them quite a lot just to get print outs. Which doesn't even bother me".

"Well, I don't mind using them but I don't like it when there are too many people waiting or people can see what I'm doing".

5.7 Discussion

The study has provided empirical evidence of several personal and non-personal constructs that influence attitude towards ATM use. The interviews illustrate how attitude towards use is affected by personal concepts: space, time pressure, privacy, safety and non-personal concepts: ease of use, location and usefulness.

The study supports previous works such as Lucas & Spitler (1999) in that external factors are an important influence on technological adoption and use. This study posits that the main variables included in TAM (perceived usefulness and perceived ease of use) are not the only major determinants of ATM use. External variables such as perceptions of privacy and security influence use directly. Therefore, mechanisms that determine user behaviour of technological systems in public areas, such as an ATM, are more complex than stated in TAM. TAM has been successfully applied to specific research areas such as technology adoption in the workplace (see Davis 1989). However, the findings from this study suggest that when applying TAM to explain user behaviour or adoption of technological systems in public areas new and/or expanded theoretical models are needed such as the model of ATM use proposed here.

5.7.1 Rethinking space and social density

As stated earlier a non-monotonic relationship appears to exist with regard to the amount of space and ATM use. An increased risk of crime is perceived when using an ATM and density is too low and space is high, when density is too high then negative effects of crowding occur. The ability to predict behaviour appears to vary in terms of the number of people around. When ATMs are located in areas that are classed as 'too open' this also has a negative affect on use. This finding supports Knowles (1979) in that it is not density per se but the proximity of others that is important. The findings from this study suggest that negative effects associated with crowding occur due to interference with the actual activity or task.

Context is a major factor when considering an individual's reaction to invasion of their personal space (Harris et al 1978). Queuing causes discomfort not only to the ATM user but also to the people waiting. Negative effects of queues result in reduced levels of personal space and privacy and also a self-imposed time pressure prevails. The amount of space utilised describes and communicates to others the level an individual requires for privacy and freedom from others observations however intrusion into this space often occurs. When desired levels of privacy and personal space are not met people begin to feel uncomfortable and make behavioural adjustments to compensate e.g. looking behind. As Pruyn & Smidts (1998) suggested queuing may be influenced by cognitive and affective components of an individual's attitude. For example, an individual queuing may have limited time to wait in a queue (cognitive) therefore by showing irritability (affective) they perceive this will hurry the user in finishing his or her task.

5.7.2 Privacy revisited

Privacy is a human boundary process that allows access by others according to one's own need and situational factors. An ATM user is affected by both social and physical situational factors, a user may feel his or her levels of privacy and personal space are reduced due to crowding and the design/location of the ATM. This study has highlighted how 'shoulder surfing' by others is a major problem for users of ATMs, this supports previous research by Morris et al (1995). Users do not like being observed by others as this leads to reduced levels of privacy, personal space and safety. The findings show that privacy is bi-directional i.e. inputs from others (standing too close) result in outputs (the user only undertaking one transaction on the ATM). Palen & Dourish (2003) purport privacy is under continuous negotiation and refined according to circumstance, this study supports this view. This highlights how privacy is regulated through social interaction. Rothman (1987) stated the environment should cue appropriate behaviour and support the intended activity. In this study it appears the environment does not always support these issues.

The previous study described in chapter 4 used four of Pedersen (1999) dimensions to measure privacy issues related to ATM use: solitude (freedom from others observations), reserve (not revealing through verbal disclosure any personal information to others), isolation (being geographically removed and free from observation by others) and anonymity (being seen but not identified or identifiable by others). However findings from the study revealed the privacy model proposed by Pedersen needs to be more clearly defined as the dimensions overlap, in particular when the model is applied to systems used in a public area. Pedersen also purported that privacy is controlled and maintained by five functions. None of these functions describe how individuals control for personal information, physical privacy or unwanted input. The findings from this study also imply that privacy is a highly complex concept, differs with regard to the type of activity and that the dimensions associated with it are dependent upon situational and/or environmental factors.

Although speculative Burgoon (1982) suggested space is a control mechanism that helps maintain or reach a desired level of privacy. The findings from this study suggest that space is a very important mechanism that helps maintain or reach a desired level of privacy when using an ATM.

5.7.3 The need for time and space

Kaya & Erkip (1999) suggested that when using an ATM the transaction has to be carried out in a very short time period due to the nature of the activity. The findings from this study show that it is not just due to the nature of the activity taking place but the fact that a self-perceived time pressure exists which results from other people queuing to use the ATM. People sense they have a social obligation when using an ATM to be quick so they don't keep other people waiting. This finding supports previous research by Zimmermann & Bridger (2000) in that users of ATMs are conscious of others waiting which results in perceived time and social pressure.

Previous findings on defensible space, which relate to crime and security, suggest the need for openness and visibility (Lawson 2001). However this study suggests the area around an ATM can sometimes be too open and too visible which makes the user feel a higher risk of crime is likely than when the area around the ATM is less open or less visible to others. The exploratory study in chapter 4 reported that levels of anxiety were a significant predictor of ATM use. Participants rated feeling more anxious when queuing compared to actually using the ATM. In this study several concepts have emerged that can make people feel anxious when either using the ATM or when queuing e.g. time pressure, observation by others, safety. Chan (2000) suggested the primary way in which individuals achieve privacy is through manipulation of space. The findings from this study also suggest that space is an important construct that helps maintain or achieve a desired level of privacy. Safety concerns exist over PINs, the industry is currently addressing these problems with research into images as visual stimuli are easier to remember and also helps people with certain cognitive deficits and literacy problems.

The previous study suggested individuals would prefer to use an ATM in a local store. However, the finding in this study opposes the previous one. Although participants stated they were convenient and safer, many thought ATMs in local stores were less private and lacked space. The contradiction is interesting, at the time of the first study ATMs in local stores were not commonplace but now they are. Although the location is classed as convenient will people accept the benefit over reduction in privacy and personal space? This question is important as the future predicts anytime, anywhere use of technologies.

5.8 Chapter Summary

This study has provided important evidence that attitude towards use of an ATM is influenced by external constructs privacy, space, safety, time pressure, ease of use, usefulness and location. By using a qualitative approach (grounded theory) certain constructs have emerged that have not been previously considered e.g. time pressure.

The proposed model of ATM use provides a practical tool for assessing and measuring use of technological systems in public zones. The findings highlight a complex inter-relationship exists between several constructs. The need to further understand and explore this relationship is important.

Chapter 6

Assessing ATM use and developing a psychometric tool

The research in chapter 5 found perceived levels of privacy, personal space, time pressure, safety, ease of use, location and usefulness all influence the use of technology in public places. The study reported in this chapter aimed at developing a psychometric tool to measure those influences. Three hundred and seven participants who were either frequent or non-frequent automated teller machine (ATM) users completed a questionnaire related to attitude towards ATMs. The development of the questionnaire has provided a valid and reliable psychometric tool that measures those variables that influence use. The results of the study confirm perceived ease of use, usefulness, privacy and personal space significantly effect attitude and intention towards use of technology in public places.

6 Introduction

The qualitative study described in chapter 5 found attitude and intention towards use of an ATM was influenced by the following personal constructs: perceived levels of privacy, space, time pressure and safety. Non-personal constructs that emerged were usefulness, ease of use and location. Usefulness and ease of use support TAM in its assertion that these factors are two key predictors of intention to use a system.

The study supports previous research such as Lucas & Spitler (1999) in that external variables are an important influence on technological adoption and use. The study also posits that the main variables included in TAM (PU and PEOU) are not the only major determinants that influence the use of an ATM in a public area but consideration must be given to other external variables such as privacy.

6.1 Aims

One of the major goals of this thesis is to develop a valid and reliable scale that measures factors that influence the use of technology in public places. This involves finding and selecting a homogeneous set of items that most strongly influence use. Therefore the aims of the present study are to begin this process. To validate previous findings that external variables such as privacy affect attitude and intention towards use. Also to develop a questionnaire and to test its psychometric properties. Also to determine how the measured variables fit with TAM.

Current questionnaires tend to focus on adoption or non-adoption of technology. For example, Technology Profile Inventory (DeYoung & Spence 2004), Technology Acceptance (Davis 1989) and Computer Attitudes Scale (Nickell & Pinto 1986). At present there exists no methods or tools that measure socio-environmental influences on the use of technology in public areas. As use of technology in public places is a common occurrence the HCI community needs to acknowledge that existing methods and approaches need to be expanded to account for social and environmental influences.

6.2 Methodological approaches

As discussed in chapter 3 developing a reliable and valid psychometric tool needs careful planning. The actual questions need to be designed to help achieve the goals of the research and in particular answer the research question (Robson 2002). Respondents must be able to understand the questions in a way the researcher intended. One way to validate questions is to pre-test on a sample of people homogeneous to the population the research is aimed at. Pre testing raises criticisms and identifies problems inherent in the way questions are worded. Day & Evers (1999) discussed development of a questionnaire for multicultural data collection. In the pilot stage of development they asked four types of experts (English language, software professionals, HCI scholars and International study experts) to evaluate the questionnaire. They suggested this type of pre evaluation leads to a substantially clearer and more precise survey.

One technique widely used in both HCI and psychological testing is the card-sort method. The card-sort technique can be used for exploring how people group items (Gaffney 2000). Respondents are given a set of cards containing several statements. Participants then sort these statements into categories that are usually predetermined. Sorting can help identify items that are difficult to understand or categorise. In usability research emphasis is made that all participants who sort the statements and categorise them must be representative of the target population.

Davis (1989) used a card-sort technique and predetermined categories to evaluate statements related to perceived ease of use and perceived usefulness. The study reported in this chapter employs a similar methodology to the card-sort approach. However instead of asking people to sort each statement according to a predetermined category, they sorted fifty-six statements and were asked to label each one according to the concept they believed it to be.

6.2.1 Card-sort approach

A similar procedure to the original card-sort method was initially employed in the pre test study. This involved an opportunity sample of fifteen participants sorting fifty-six statements derived from each of the constructs that emerged from the qualitative study in chapter 5 (privacy, space, safety, time pressure, ease of use, usefulness and location). The sample consisted of 10 females and 5 males, aged from 18 to 56 years (mean 32.3). The fifty-six statements were randomized to reduce response bias. Participants were asked to read and record what concept they believed each statement was measuring.

6.2.2 Questionnaire and statement development

From the previous study reported in chapter 5 eight statements were developed related to each of the constructs: personal space, privacy, safety, time pressure, ease of use, location and usefulness. The fifty-six statements reflected user attitudes towards use of an ATM. The majority of the statements in each of the subscales were explicitly linked to past research. For example, the statements for privacy were based on four of the dimensions proposed by Pedersen (1999): solitude (e.g. I do not like being observed by others when I use an ATM.), anonymity, reserve (e.g. When I use an ATM I am concerned other people can see personal information) and isolation. Statements related to usefulness (e.g. I am only interested in using ATM's for cash withdrawal) and ease of use (e.g. I find ATM's easy to use) were based on research by Davis (1989).

6.2.3 Card-sort comparison

All responses to each of the fifty-six statements were recorded and compared. Statements from each of the seven constructs were chosen if the majority of participants recorded a similar concept to the one it was originally purported to be. Comparison of the responses for the construct 'location' revealed overall consensus for only three statements. After analyzing the card-sort responses for location it became apparent that some of the statements were ambiguous and somewhat misleading. Therefore on the final questionnaire participants rated different locations for amount of privacy, personal space, safety, time pressure, ease of use and usefulness. Ratings were made on a scale from 1 (not sufficient) to 7 (sufficient). The ratings would then give further insight and comparison of how different locations impact upon use of ATMs.

Findings in the previous study suggested that two of the core constructs were similar to those proposed by TAM: perceived usefulness and perceived ease of use. The final constructs included in the questionnaire related to levels of perceived privacy, space, safety, time pressure, ease of use, usefulness, social interaction. Also attitude and intention to use the device were measured.

After further comparison of the card-sort responses two statements were dropped from each of the remaining constructs leaving six per construct. Some statements in the various categories were slightly reworded, as in their original format appeared ambiguous. For example, the statement 'I only use ATMs for cash withdrawal' related to the usefulness of the system. This statement was reworded to ' I am only interested in using ATMs for cash withdrawal'. Two statements originally classified as privacy 'I do not like anyone to speak to me when I use an ATM'; 'I avoid looking directly at the ATM user' and one space statement 'When I am waiting to use an ATM I deliberately avoid contact with the user'. were reclassified as 'social interaction'. This was from consensus by participants on the card-sort that suggested these statements related to social interaction with others. Although the concept of 'social interaction' had not been previously considered a decision was made to include these three statements in the final questionnaire as that construct.

After comparison thirty-nine of the statements were incorporated into a questionnaire to measure attitude and intention towards ATM use. The final questionnaire consisted of six statements related to privacy, personal space, time pressure, safety, usefulness, ease of use and three statements for social interaction. Three statements were developed to measure actual attitude and intention towards ATM use respectively. Nine different locations where ATMs are generally used e.g. railway station, local high street, were incorporated into a table and rated by participants for privacy, safety, personal space, time pressure, usefulness and ease of use. The final statements incorporated into the questionnaire are listed below in their respective category (see Appendix B for the actual questionnaire):

Personal space (social density)

1. When someone is using an ATM I believe other people stand well back.

2. When I am using an ATM I feel people waiting to use it don't give me enough space.

3. I feel I have to stand to close to the user when I am waiting to use an ATM.

4. I feel uncomfortable using an ATM when there is someone queuing behind me.

5. I believe there is generally enough space around me when I use an ATM.

6. When I use an ATM I feel there is not enough space behind me for people to pass by.

Time pressure

7When there is a queue you have to hurry when using an ATM.

8. I feel you can only undertake one transaction on an ATM if there is a queue.

9. I feel under pressure when there is a queue at an ATM.

10. I believe people should take as long as they like when they use an ATM.

11. I believe you have to use an ATM quickly in certain locations e.g. railway stations.

12. I feel I have to spend less time using an ATM if other people are waiting.

Usefulness

13. I would like to use ATM's to do other transactions not related to my bank account (e.g. purchase tickets).

14. I believe ATM's should only be used for banking purposes.

15. I believe more functions on an ATM would be helpful.

16. ATM's do not offer all the financial services I would like them to.

17. I am only interested in using ATM's for cash withdrawal.

18. I find I can do all the financial things I need to do on an ATM.

Privacy

19. When I use an ATM the only time I feel I have enough privacy is when no one else is around.

20. I do not like being observed by others when I use an ATM

21. I feel as if other people watch me when I use an ATM.

22. Other people can see what I'm doing when I am using an ATM.

23. When I use an ATM I am concerned other people can see personal information (e.g. my account balance).

24. I would feel uncomfortable if a close family member or friend saw my personal financial information on an ATM screen.

Safety

25. I assess the area to make sure it is safe when approaching an ATM.

26. I believe there is a high risk of being robbed when using an ATM.

27. I feel vulnerable when using an ATM.

28. I feel at risk if I spend too much time using an ATM.

29. It does not bother me using an ATM when there is no one else around.

30. When I use an ATM other people's behaviour nearby makes me nervous.

Ease of Use

31. I find ATM's easy to use.

32. I feel comfortable with the design of ATM's.

33. I think ATM's are a simple way of accessing cash.

34. When I use an ATM I find the instructions clear and understandable.

35. I find using an ATM frustrating.

36. Learning how to use an ATM is difficult for me.

Social interaction

37. I would not like anyone to speak to me when I am using an ATM.

38. When I am waiting to use an ATM I deliberately avoid contact with the user.

39. I avoid looking directly at the ATM user.

Attitude

40. All things considered, I find using ATM's a negative experience.

41. All things considered, I find using ATM's a frustrating experience.

42. All things considered, I find using ATM's a good experience.

Intention

43. I intend to use an ATM in the next week to:

a) Withdraw cash from my account

b) Check my account balance

c) Deposit money into an account

6.3 Questionnaire- method

The main study used a non-experimental independent measures design. Variables that were measured were participants' subjective ratings of levels of privacy, personal space, safety, time pressure, ease of use, usefulness, social interaction, attitude and intention to use an ATM. Participants rated different locations they had used ATMs for amount of personal space, privacy, safety, time pressure, ease of use and usefulness. Details about the ATM each participant used most often were also recorded. Participants rated the ATM they used most frequently for privacy, how many people were generally around, how often they used the ATM per week, the time of day and how often there was a queue at that particular ATM.

6.3.1 Participants: questionnaire

Three hundred and seven participants from the Northeast of England completed the questionnaire related to ATM use. 125 males, 182 females, age range 16–90 years (mean 49.63). All participants were chosen by opportunity sampling and stated they used ATMs. Participants were recruited from two different locations in Newcastle upon Tyne, UK: Seaton Delaval and Gosforth.

6.3.2 Procedure

Questionnaires were delivered by hand to 1100 homes in two different areas in Newcastle. A full explanation of the research and instructions on how to complete the questionnaire were included in the delivered package. Participants were asked to read and respond to all questions by recording their responses on a continuum bipolar scale of 1-7. After completion participants were asked to return the questionnaire in the pre-paid envelope provided to Northumbria University, Newcastle by 20th November 2002.

6.3.3 Testing for reliability and validity

Prior to further analysis all variables were examined through SPSS programs for accuracy of data entry, missing values, fit between their distributions and the assumptions of multivariate analysis. A total of 361 questionnaires were returned, 307 were fully completed this gave an overall response rate of 32.81% of which 27.9% questionnaires were used for further analysis

Each of the subscales showed a high level of internal consistency, with coefficient alphas in the range of .64 to .83, mean alpha = .76 (details of the reliability outputs can be found in Appendix B). The alpha coefficients related to each subscale were: time (.7988), space (.6949), privacy (.7728), safety (.7984), ease of use (.7242), usefulness (.6180), social interaction (.5700), attitude (.8016), and intention (.5083). The statement related to usefulness '*I find I can do all the financial things I need to do on an ATM*' was dropped from further analysis, this increased alpha to .8290. The statement related to social interaction '*When I am waiting to use an ATM I deliberately avoid contact with the user*' was dropped from further analysis, this increased alpha to .6479. The statement related to intention ' *I intend to use an ATM in the next week to deposit money into an account*' was dropped from further analysis, this increased alpha to .6945. Table 6.1 provides an overview of the coefficient alpha, mean and standard deviation related to each construct.

Construct	Alpha	Alpha if statement dropped	Mean response	Sd.
Time	.7988		3.61	1.31
Space	.6949		4.16	1.09
Privacy	.7728		3.26	1.19
Safety	.7984		3.67	1.22
Ease of Use	.7242		5.70	.97
Usefulness	.6180	.8290	3.72	1.51
Social Interaction	.5700	.6479	2.91	1.19
Attitude	.8016		5.11	1.34
Intention	.5083	.6945	5.11	1.89

Table 6.1: Alpha coefficients, means and standard deviations for the each of the subscales used in the questionnaire

6.3.4 Factor Analysis: discriminating between variables

To ascertain whether the questionnaire measured multiple distinct factors a principle components analysis with varimax rotation was applied to the data (details of the principle components analysis can be found in Appendix B). Eight components with an eigenvalue greater than 1 were extracted. The first six included at least three items and were sensibly interpretable. These factors explained 52.85% of the total variance and were labeled: Social Requisites, Usefulness, Ease of Use, Time Pressure, Social interaction, Environmental Space. After rotation the factors produced eigenvalues 7.07, 3.09, 2.86, 2.82, 1.96 and 1.74 respectively. Factor loadings are shown in Table 6.2.

Item No.[1]	Item Measure[2]	Factor[3] 1 Social Requisites	2 Usefulness	3 Ease of Use	4 Time Pressure	5 Social Interaction	6 Environmental Space
25	Safety	**.772**	-.020	.081	.205	.047	.035
27	Safety	**.761**	.061	.120	.106	.138	.098
21	Privacy	**.714**	-.092	.143	.208	.090	.158
20	Privacy	**.714**	-.010	.019	.223	-.064	.087
2	Space	**.683**	-.077	.069	.149	-.125	.100
4	Space	**.680**	-.066	.197	.155	.157	.081
30	Safety	**.659**	-.093	.051	.009	.231	-.046
22	Privacy	**.650**	-.065	.134	.055	.286	.191
24	Privacy	**.644**	.004	-.004	.089	.434	.050
26	Safety	**.632**	.111	.254	.123	.225	.113
8	Time	**.606**	-.068	.132	.521	.013	.066
19	Privacy	**.554**	.009	.041	.234	.043	.153
29	Safety	**.553**	-.032	-.083	.030	.450	-.204
9	Time	**.547**	-.005	.043	.439	-.026	-.079
13	Usefulness	-.129	**.854**	.011	-.120	.020	.082
14	Usefulness	.066	**.827**	-.055	.050	.068	-.146
15	Usefulness	-.004	**.805**	.046	-.024	-.015	-.005
16	Usefulness	-.101	**.723**	-.154	-.080	.030	.074
17	Usefulness	.112	**.605**	.066	.202	-.151	-.191
33	Ease	.221	.015	**.717**	.117	.006	-.220
35	Ease	.139	-.040	**.711**	.058	-.014	.026
36	Ease	.057	-.138	**.609**	-.062	-.074	.121
34	Ease	.169	-.055	**.574**	-.035	.073	.169
31	Ease	.063	.091	**.560**	.098	.139	-.355
32	Ease	-.067	.069	**.545**	.015	-.002	.245
12	Time	.265	-.024	-.014	**.780**	.239	.089
11	Time	.257	-.032	.030	**.769**	.206	.136
7	Time	.300	-.088	-.026	**.642**	-.107	-.106
3	Space	.335	-.028	.287	**.447**	.027	.103
23	Privacy	.038	.140	.279	.163	**.779**	-.046
39	Soc.Int	.349	-.040	-.112	.202	**.514**	.055
37	Soc.Int	.262	-.024	-.113	-.015	**.489**	.025
1	Space	.117	.067	-.038	-.011	.041	**.715**
6	Space	.233	-.061	.137	.242	.002	**.593**
5	Space	.485	-.108	.263	.015	-.103	**.537**
10	Time	.009	.005	.055	.192	-.068	.044
28	Safety	.106	.044	.119	.104	.108	.034

[1]Ordinal position of item in section 6.2.2 of this chapter
[2] Items are listed in descending order of magnitude
[3] Factor loadings ≥ .40 are in boldface

Table 6.2: Component Loadings after rotation of the 37 items related to each subscale on the questionnaire

6.3.4.1 Interpretation of the factor analysis

The factor analysis suggests that response towards the use of technology in public areas is more complex than existing models of technology acceptance such as TAM. Two components (Usefulness and Ease of use) are the same as PU and PEOU proposed by Davis (1989) in TAM. Variables in the first factor Social Requisites highlight how personal space, privacy and safety when related to technology use in public areas are not distinct measures. The interrelationship between these variables is acceptable as the amount of personal space can either increase or decrease perceived levels of privacy and safety. Time pressure and Social Interaction emerged as two other distinct factors.

The component loadings revealed a personal space statement *'I feel I have to stand to close to the user when I am waiting to use an ATM'* correlated significantly (.447) with the factor Time Pressure. This may be due to actually including the word 'waiting' in that particular statement, therefore associating this more with 'time' than 'space'. Interestingly the component Social Interaction includes two privacy and one safety statement in the factor loadings: *'When I use an ATM I am concerned other people can see personal information' (privacy), ' I would feel uncomfortable if a close family member or friend saw my personal financial information on an ATM screen' (privacy)* and *'It does not bother me using an ATM when there is no one else around' (safety).* This again maybe a result of the wording in the statements as all imply some type of social interaction with another person. As the last factor Environmental Space only included three items this renders the stability of this component questionable. This highlighted the importance of questions related to 'space' in future research need to be worded specifically and related to the self as opposed to the general environment. Therefore the component Environmental Space was dropped from further analysis leaving five main components: privacy, space, safety, ease of use and usefulness.

6.3.4.2 The need for independence

Although space, safety and privacy are interrelated they are still separate concepts that need further investigation. Space is known to be a mechanism used to regulate privacy and safety. When considering interaction with technology in public places in particular ATMs the need for different levels of privacy, space and safety is variable at any given moment in time. Therefore further analysis needs to consider independently how each variable directly affects attitude and intention to use a system and to what extent.

6.4 Measuring attitude and intention to use an ATM

One of the main challenges in this thesis is to find how and what factors influence the use of technology in public areas. The factor analysis has provided empirical evidence of five stable components that influence the use an ATM. Factor analysis does not show any directional influences therefore another approach is required to find relationships between variables. Therefore Structural Equation Modeling (SEM) was used to further analyse the data. SEM looks for relationships between the components and highlights any complex interrelationships (the SEM output can be found in Appendix B). As Ease of Use and Usefulness were found to be two major components related to use of an ATM the initial SEM analysis was based on TAM.

6.4.1 SEM results

A SEM approach was used to analyze the data using EQS software. Maximum likelihood estimation was used to find how the measured external variables fitted in relation to TAM. Little support was found for this model, Chi-square = 670.65, DF=15, $p < .001$; CFI = 0.25; RMSEA = 0.38.

Post hoc modifications were performed in an attempt to develop a better fit and more parsimonious model. On the basis of the Lagrange Multiplier there was no significant relationship between intention and the following three variables: time, safety and privacy. The Wald test revealed several paths should be deleted to develop a better fit model: usefulness and safety, ease of use and usefulness, attitude and time. The revised model provided an extremely good fit to the data, Chisquare = 1.34, DF=3, p=0.72; CFI = 1.00; RMSEA = 0.00 (see Table 6.3).

	TAM	NEW MODEL
CHISQUARE	670.65	1.34
CFI	0.25	1.00
RMSEA	0.38	0.00

Table 6.3: Comparison between the two models fits

The model provides evidence that space (0.18), privacy (0.17), usefulness (0.12) and ease of use (0.51) are all predictive of attitude towards use of a technological system used in a public area. Contrary to the TAM, the revised model also suggests that Space (-0.22), Usefulness (0.16) and Ease of Use (0.25) are directly related to Intention to Use such a system.

Significant relationships were also evident between several of the independent variables (see Figure 6.1).

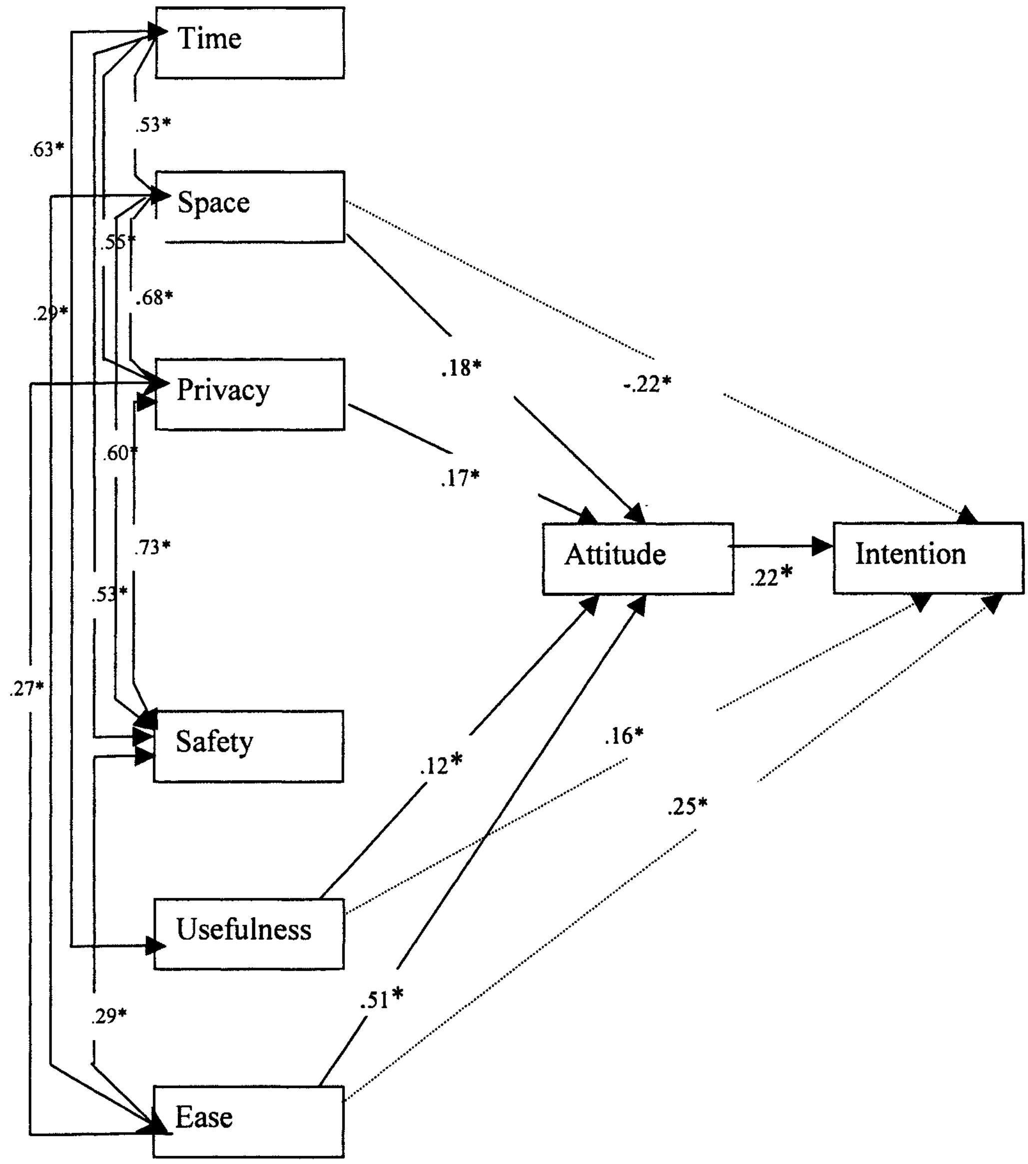

Figure 6.1: Revised Technology Acceptance Model for use with Public Space Devices (TAMPS)

6.4.2 Summary

The SEM analysis has provided empirical and important evidence that external variables have a direct effect on attitude towards the use of an ATM in a public area, as well as on Intention to Use such a system. The findings show perceived levels of privacy, personal space, ease of use and usefulness affect the level of use of an ATM. This study proposes a new model to measure technology use in public place the Technology Acceptance Model for Public Spaces (TAMPS).

The findings support previous works such Lucas & Spitler (1999) in that external factors are an important influence on technological adoption and use. This study posits that the main variables included in TAM perceived usefulness (PU) and perceived ease of use (PEOU) are not the only major determinants of ATM use. External variables that are both personal and non-personal influence use of an ATM in a public area. Interestingly TAM purports PU as the major factor associated with technological adoption and use accounting for 50% variance. Davis also postulated that PEOU was a secondary factor in determining system use and was mediated through PU. Results from this study show PU accounts for only 12% of the variance related to attitude towards system use and 16% related to intention. PEOU is found here to be a major determinant of use accounting for 51% of the variance related to attitude towards use and 25% related to intention. This finding supports previous research (e.g. Geffen & Straub 2000) in that PEOU directly affects adoption and use of systems. This study has found empirical evidence that PEOU directly affects both attitude and intention towards system use. Unlike previous research (e.g. Davis) no significant correlation was found between PU and PEOU. This thesis also supports the view that the majority of studies that use TAM in their research fail to show the importance of PEOU.

6.4.3 Importance of space

Findings show 'space' has a direct positive affect on attitude and negative affect on intention. This is interesting as it suggests that although a user may have a positive attitude towards use of an ATM, his or her intention can be changed with regard to the amount of available space in the immediate environment. This would further imply 'space' is a very important external variable that influences use. As discussed in section 6.3.5.1 space is used as a control mechanism for regulating privacy and safety. The high correlations in the model provide evidence that indeed the three variables are related. However, both space and privacy have emerged as having a direct independent effect on attitude.

6.4.4 Privacy revisited again

The questions for privacy in this study were based on four of the dimensions proposed by Pedersen (1999): solitude, isolation, reserve and anonymity. As discussed in chapter 5 the dimensions are not clearly defined and overlap somewhat making measurement difficult, in particular when the model is applied to systems used in a public area. Table 6.4 illustrates each privacy statement and the privacy dimension it relates to. Significant correlations between the statements are shown (** $p<.001$, * $p<.05$).

Dimension	Statement	1	2	3	4	5	6
Isolation	**1.** *When I use an ATM the only time I feel I have enough privacy is when no one else is around.*		.543**	.350**	.502**	.118*	.403**
Solitude	**2.** *I do not like being observed by others when I use an ATM*	.543**		.493**	.424**	.92	.441**
Solitude	**3.** *I feel as if other people watch me when I use an ATM.*	.350**	.493**		.536**	.163**	.544**
Anonymity	**4.** *Other people can see what I'm doing when I am using an ATM*	.502**	.424**	.536**		.236**	.543**
Reserve	**5.** *When I use an ATM I am concerned other people can see personal information (e.g. my account balance).*	.118*	.92	.163**	.236**		.308**
Reserve	**6.** *I would feel uncomfortable if a close family member or friend saw my personal financial information on an ATM screen.*	.403**	.441**	.544**	.543**	.308**	

Table 6.4: Correlations of privacy statements and the related dimension

The findings from this study further imply that privacy is a highly complex concept. The high correlations between the related statements and dimensions provide evidence that the categories proposed by Pedersen are not distinct. For example statement 6 is classified as 'Reserve' as it refers to not revealing personal information to others. However high relationships between this statement and statements 3 (Solitude) and 4 (Anonymity) are clear in Table 6.4.

6.4.5 Reflecting on attitude and intention

Davis et al (1989) found the influence of attitude on intention to use a system was minimal and therefore dropped the construct from TAM. The results from this study provide evidence the construct 'attitude' is important in measuring use. External variables i.e. privacy, space, ease of use and usefulness all have a direct effect on attitude and account for 98% of the total variance on this construct. The inclusion of the construct attitude in TAM supports previous research (e.g. Chen et al 2000).

6.5 TAMPS as a framework

The revised and expanded TAM proposed in this study demonstrates how external variables such as personal space and privacy have a direct effect on attitude and intention to use a system. Therefore mechanisms that determine user behaviour of technological systems in public areas such as an ATM are more complex than stated in TAM. TAM has been successfully applied to specific research areas such as technology adoption in the workplace (see Davis 1989). Findings from this study suggest frameworks are needed that account for socio-environmental influences on technology use in public areas like TAMPS developed here. TAMPS explains user behaviour or adoption of technological systems in public areas and accounts for socio-environmental factors and usability issues.

6.6 Descriptive data for Location and Use

Participants rated the use of ATMs in various locations for amount of perceived privacy, space, time, safety, ease of use and usefulness. Ratings were made on a continuum bi-polar scale from 1 (not sufficient amount) to 7 (sufficient amount). The mean subjective rating for all variables was calculated with regard to the different locations listed: railway station, local store, bank foyer, supermarket, garage, local high street, leisure centre, department store and city centre street. ATMs located internally i.e. bank foyer were rated higher on all six variables compared to ATMs located in city streets, garages and local high streets. Table 6.5 depicts the range of mean ratings related to all six variables. Locations rated high (above 4.5) for all six variables are in bold and locations rated low (below 2.5) are in italics.

	Location of ATM and mean rating								
Variables	**Railway Station**	**Local Store**	**Bank Foyer**	**Super-market**	**Garage**	**Local High St.**	**Lesure Centre**	**Dept. Store**	**City Street**
Space	3.76	3.82	**4.67**	4.02	3.99	3.54	4.00	4.20	3.27
Privacy	3.23	*2.42*	4.36	3.60	3.53	3.11	3.50	3.65	2.88
Time	3.80	4.16	**4.81**	4.34	4.23	4.06	4.31	4.25	3.68
Safety	3.71	**4.75**	**5.57**	**4.61**	3.63	3.48	4.30	**4.78**	3.76
Ease of Use	**5.63**	**5.75**	**5.96**	**5.85**	**5.49**	**5.75**	**5.49**	**5.61**	**5.74**
Usefulness	**5.48**	**5.58**	**5.91**	**5.71**	**5.18**	**5.69**	**5.19**	**5.41**	**5.63**

Table 6.5: Range of mean rating and standard deviations for ATMs on all six variables

6.6.1 Location and use

Table 6.6 shows the location of ATMs participants stated they use most often. ATMs at supermarkets were used the most by participants in the study (30%), followed by local high streets (26.4%) in comparison to ATMs used at garages (.7%) and department stores (.7%).

Location	Frequency	%
Supermarket	92	30
Local High St.	81	26.4
Bank Foyer	74	24.1
City St.	28	9.1
Shopping Complex	9	2.9
Department St.	2	.7
Garage	2	.7
Other e.g. work	3	1

Table 6.6: Frequency of use of ATMs at various locations

Participants also recorded how often they used an ATM per week, the number of people who were generally around at the time of use, the time of day and how often there was a queue at the ATM. They also rated on a scale of 1-7 how private they thought the ATM they used most frequently was for levels of privacy (see Table 6.7).

Location	Frequency of Use (per week)	Mean Privacy (Sd.)	No. of people around	Queue (how often)	Time of Day
Supermarket	**2.05** (1.51)	**48** (1.56)	**6-7** (1.58)	**3.92** (1.49)	**3-4pm**
Local High St.	**2.58** (1.86)	**32** (1.60)	**6-7** (1.61)	**3.65** (1.40)	**3-4pm**
Bank Foyer	**2.38** (2.01)	**4.61** (1.70)	**3-4** (1.39)	**3.49** (1.69)	**12noon-1pm**
City St.	**2.28** (1.21)	**3.50** (1.67)	**9-10** (1.78)	**4.07** (1.56)	**3-4pm**
Shopping Complex	**2.12** (1.24)	**4.11** (1.36)	**6-7** (1.56)	**4.56** (1.33)	**12 noon-1pm**
Department St.	**5.00** (1.24)	**4.50** (.7)	**6-7** (.70)	**3.00** (.00)	**12 noon-1pm**
Garage	**4.00** (.00)	**5.00** (1.41)	**1-3** (.00)	**2.00** (.00)	**9-10am**
Other e.g. work	**3.67** (2.08)	**4.67** (1.68)	**4-6** (.57)	**3.33** (2.30)	**12 noon-1pm**

Table 6.7: Participants mean responses (standard deviations) to various factors related to the location of the ATM they used most often.

Overall the mean frequency of ATM use for participants is approximately 3 times per week. Mean ratings for levels of privacy of ATMs that participants used in local high streets (3.32), supermarkets (3.48) and city centre streets (3.50) were rated lower compared to ATMs located in bank foyers (4.61), other places e.g. work (4.67) and garages (5.00). However the high mean privacy rating for garages may be due to the fact that only two participants stated they used a garage ATM the most often. The average amount of people around when participants were using ATMs was 6-7. The mean responses for how often there were queues at ATMs shows there are regularly queues at all locations. Queues at shopping complexes (4.56) occur more frequently than queues at garages (2.00). The time that ATMs appear to be used most often is between 12am – 1pm.

6.7 Discussion

Two clear aims set out in the introduction of this chapter have been established. The first was to develop a valid and reliable psychometric tool that measures attitude towards technology use in public areas. Developing the statements from the findings reported in chapter 5, the use of a q-sort methodology and a factor analysis has added to the validity of the questionnaire. The five components found in the analysis provide a homogeneous set of variables that influence system use. The proposed model TAMPS developed through SEM provides a practical research framework for assessing and measuring use of technological systems in public zones.

This study has provided important evidence that attitude and intention towards use of a technological system in a public area is influenced by privacy, personal space, ease of use and usefulness that have a direct effect on use. Hsu & Lu (2003) reported social and environmental pressures can have a profound impact on user behaviour. Findings from this study support this view in that environmental and social pressures are both implicated and affect use of public space technologies. As outlined in chapter 3 this thesis made a clear distinction between environmental and social influences. For example, environmental influences are associated with the immediate environment, location and design. Social influences are associated with interaction with other people. Social pressures from other people around the area can affect a user's perceived levels of privacy, personal space and safety. Environmental pressure can either have a direct and/or indirect affect on use from the immediate environment the system is located.

Previous research that has applied TAM has been criticized for sampling bias e.g. students as participants. The study reported in this chapter recruited actual users and therefore results are high in ecological validity.

6.7.1 Review of location data

Although descriptive the data from the category location yields some interesting implications for design and placement of future systems. Participants stated the average number of people around when they used an ATM was 6. Maguire (1998) stated systems used in public places should be designed so the user's body conceals their interaction. Often the design and placement of ATMs does not allow for total concealment of the interaction as generally two ATMs exist side by side particularly in places like supermarkets and bank foyers. ATMs located externally are considered to be less private, lack space and unsafe compared to internal ATMs found in bank foyers.

6.7.2 Implications

Understanding use can help designers and service providers identify areas that hinder acceptance and use of systems. These findings lead to several principles for both design and placement of ATMs:

- Immediate environment must support the intended use of the system
- ATMs should be placed in environments that afford privacy, space and safety
- Design specification must consider the number of people around at the time of system use
- Need to consider user population and their characteristics (this is reflected in the reported standard deviations associated with privacy ratings)
- Need to consider the type of task the system is to be used for

6.8 Chapter Summary

The study reported in this chapter has provided important evidence that perceived levels of privacy, safety, personal space, ease of use and usefulness, influence attitude and intention towards use of an ATM. The findings demonstrate external variables have a direct effect on system use. The proposed model TAMPS provides a practical tool for assessing and measuring use of technological systems in public zones.

The development of the questionnaire has provided a valid and reliable psychometric tool that measures factors that influence the use of technology in public spaces. The next stage of this thesis is to further validate and shorten the questionnaire reported on in this chapter. This will help develop the questionnaire into a precise measure of technology use in public areas.

Chapter 7

Evaluating use of both static and mobile systems

The study in chapter 6 investigated those factors that influenced public use of one of the most popular public technologies – the ATM, and found a key role for perceived privacy and personal space. The study reported in this chapter has several aims. Firstly to establish whether similar social pressures apply to other technologies used in public places. Secondly, to further test a psychometric tool for the measurement of social influences on public use of technology. Finally to explore how individual differences influence the use of different types of system. The original questionnaire reported in the previous chapter was shortened to make a more concise measure. The new shortened version was placed on the Planetsave.com website. The survey asked for volunteers to complete a short survey with regard to technology use in public areas. The form asked participants to complete only one questionnaire related to either use of ATMs, public information kiosks (PIKs), computer use in Internet cafés or mobile telephones. An exploratory questionnaire related to individual differences was also included. Findings show use of both static and mobile devices is influenced by the following external variables privacy, space, ease of use and usefulness.

7 Introduction

The study reported in chapter 6 found important evidence that attitude and intention towards use of an ATM is influenced by perceptions of privacy, space, ease of use and usefulness. The findings again support previous research (e.g. Lucas & Spitler 1999) in that external variables have a major impact upon use of a system. The TAMPS model proposed in chapter 6 demonstrates how external variables influence use. Therefore mechanisms that determine user behaviour are complex and need to be fully understood so systems can be developed and used efficiently, satisfactory and safely.

Various systems are now used in public places ranging from static (e.g. ATMs PIKs) to mobile devices (e.g. telephones, PDAs, laptops). So far this thesis has provided important evidence that users of static systems such as ATMs are influenced by several variables. However is use of other systems compounded by similar or diverse problems as those already known to influence ATM use?

Already a number of factors are known to affect mobile telephone use and these include ease of use and motivation (Kwon & Chidambaram 2000), age (Brodie et al 2003) and gender (Ling 2001). Love & Perry (2004) investigated people's perceptions and behaviours when confronted with someone having a conversation on a mobile telephone in a controlled environment. They found people tended to turn away from the caller, adopted closed postures e.g. folded arms and tended to focus attention on something else in the room. Most participants in Love & Perry's study appeared to try to ignore the call by visibly not looking at the caller. These findings are similar to research carried out by

Humphrey (2003) who noted that although bystanders tend to eavesdrop on mobile telephone conversations they try to pretend they are not listening. These forms of behaviour acknowledge that user's of mobile telephones need a certain level of privacy from the immediate environment. Also how bystanders deal with this type of interaction through civil inattention. Goffman (1963) proposed civil inattention as a way people create a private space i.e. they pretend not to look or listen, so they do not intrude on another person undertaking a task

Research by Ling (1999) has also discussed problems that exist for bystanders when someone is engaged in a conversation on a mobile telephone. His research highlighted how certain locations such as restaurants are classed as inappropriate places for mobile telephone use. When Ling (2004) invaded mobile telephone users' space in a store he noticed individuals move away when their space was violated and carried on the conversation elsewhere. Ling suggests mobile users are alert to the need for space around them but does not discuss why. This finding highlights the need for both personal space and privacy. However, previous research does still tend to ignore factors that influence the actual mobile user.

Internet cafés were first introduced in the UK in the early 1990's since then the use of computers in such places has risen dramatically. Liff & Steward (2003) state even if individuals have access elsewhere (e.g. at home), many prefer to use computers in Internet cafés as they are considered a sociable place to be. The design of many cafés places food and coffee consumption separate from actual computer use. Having separate areas is considered more appropriate and increases privacy for computer users. However privacy in some cafés can be violated dramatically. Liff & Steward discuss the case of McNulty's café that used to exist in a major UK city. The café had large overhead screens which were linked to various channels e.g. MTV, Internet. The staff were suppose to monitor what was actually being shown on the screen but sometimes they forgot. This often led to users having their private information displayed on the large screens in full view of everyone else in the café. Events like this raise concern over levels of privacy when using devices in public places such as computers in Internet cafés.

The installation and use of public information kiosks (PIKs) on city streets, airports and department stores is on the increase. Self-service technology in stores is increasingly becoming commonplace with benefits for both the service provider and the user. Users are known to spend more when using an in-store PIK and can use the system for various queries. One type of PIK that is increasingly being installed in various places is the health information kiosk (HIKs). HIKs can be used to access a variety of health related information. At present the majority in the UK are located in GP's surgeries, hospitals and pharmacies, however this is set to change and HIKs will be found almost anywhere e.g. libraries. Accessing health information is personal and dependent upon what advice is being sought. Users of HIKs need a certain level of privacy and comfort from their immediate environment. As advances are made in mobile and ubiquitous systems a fundamental issue for designers of such systems should surely be 'what are these influences and what is their net effect?'

7.1 The Internet as a viable research tool

Over the past few years the use of the Internet as a research tool has become commonplace. The Internet generally gives a research team access to a large number of potential participants from diverse populations and at a low cost. However several problems have been discussed that make the method often questionable. Research using the Internet has been criticised for lacking validity, reliability, sample bias, repeat participation and mischievous response (Schmidt 1997). Cronbach (1990) argued conventional and computer versions of a test do usually measure the same variables of interest. He suggested problems arise due to the fact reliability can easily change and that administration is psychologically different. However Cronbach was referring to computer based tests and not Internet research. Buchanan & Smith (1999) state Internet research must establish that it is robust to such challenges.

Sampling bias has been a major criticism of Internet research. Early criticisms highlighted response bias in Internet surveys, as the majority of participants were white, middle class young males from North America. The Internet user population is continuously expanding. For example, a recent poll by HarrisInteractive cited 67% of American adults were now on-line compared to 9% in 1995 (Taylor 2003). Although users tend to still be predominantly white, with some college education, there was an overall increase in the age range of users with a slight drop in users over the age of fifty. When considering sample bias reference must be made to the fact a vast amount of psychological research uses homogeneous groups e.g. students and are reported in journals without much fuss. Therefore in certain respect Internet samples may be more representative of the normal population. For example, the research carried out by

Buchanan & Smith (1999) used a student population in their paper condition and posted the Internet survey on psychological research sites. Responses to the Internet survey were from a wider age group and more global population. Buchanan & Smith (1999) compared the validity and reliability of a paper versus Internet test. Both types of data showed the same psychometric properties Hewson et al (1996) highlighted posting on research or similar sites produces response bias due to the very fact that they tend to attract people who are interested. However response bias can occur in all research and in particular through the use of opportunity sampling. Potential participants in a street or students in a laboratory must surely have some interest in taking part in a study otherwise why would they volunteer! Therefore the Internet as a research tool appears to be a valid and reliable tool. As access across age groups and different populations increase the likelihood of results that are more representative of the normal population will be commonplace.

7.2 Aims

Several challenges are set out in this chapter. The aims of the current study are:

- To validate a shortened version of the questionnaire developed in the previous chapter
- To measure factors that influence the use of several technologies used in public areas: automated teller machines (ATMs), public information kiosks (PIKs), computer used in Internet Cafés and mobile telephones
- To explore individual differences with regard to technology use in public areas
- To compare findings of ATM use from a conventional versus Internet based research

7.3 Design

A non-experimental independent measures design was used in this study. Variables that were measured were participants' subjective ratings of levels of privacy, personal space, safety, time pressure, ease of use, usefulness, social interaction, attitude and intention to use ATMs, public information kiosks (PIKs), computers found in Internet cafés and mobile telephones. A questionnaire was also included to measure individual differences this related to nine personality traits: extroversion, dominance, openness, social interaction, tolerance, anxiety, empathy, co-cooperativeness and novelty seeking.

7.3.1 Establishing reliability and validity

The original 45-item questionnaire developed in chapter 6 was found to have a good measure of internal consistency and produced a coefficient alpha .7580. However a decision was made to reduce the items to produce a short concise questionnaire.

A Principle Components Analysis was applied to all 45 items on the original questionnaire (the principle components output can be found in Appendix C). By careful consideration of item loadings and assessment of coefficient alphas the questionnaire was reduced to 24 items. On the basis of the scree-plot analysis and factor interpretability, six main factors were extracted. They accounted for 64% of the total variance and each had an eigenvalue index greater than 1.5. The interpretation of the factors was based on the grouping of variables from the original questionnaire. The rotated factor matrix is reported in Table 7.1.

	Social Requisites	Ease	Usefulness	Time	Social Interaction	Intention
1	.725					
2	.664					
3	.663					
4				.678		
5				.803		
6				.838		
7	.633					
8	.749					
9	.693					
10			.873			
11			.868			
12			.800			
13	.734					
14	.601					
15	.740					
16		.713				
17		.753				
18		.565				
19					.752	
20					.784	
21	.306	.736				
22	.305	.763				
23		.352				.761
24						.910

Table 7.1: Rotated factor Matrix (Coefficients lower than .3 have been omitted).

The first factor extracted was classified as 'social requisites' and accounted for 20.25% of the total variance. This factor includes such variables as privacy, safety and amount of personal space, the same variables found in the factor analysis reported in the previous study in chapter 6. The SEM analysis provided evidence although highly related privacy, space and safety are still independent constructs. The interrelationship is important as space is used as a mechanism to control privacy and safety. However finding and accounting for how much variance each variable influences use is important for future design of systems. By consideration given to the PCA and alpha levels 9 items were dropped (3 questions for privacy, 3 for space and 3 for safety). The coefficient alphas for the three questions retained pertaining to individual concepts were privacy (.7088), space (.6661) and safety (.8311), further evidence for independence and reliability of these variables. Two questions categorised as 'attitude' were also found to be associated with factor 1, however as the loadings were around .3 it was deemed appropriate to ignore these items.

The second factor extracted was classified as 'ease of use' and accounted for 12.22% of the total variance. By consideration given to the PCA and coefficients alphas a decision was made to drop 3 of the items from the original 6 items that measured ease of use. This produced a coefficient alpha for the new 3-item factor of .7950. Two items categorised as 'attitude' were also found to load high on factor 2 above.73. The actual questions related to 'ease of use' and 'attitude' appeared to be asking the same type of questions e.g. difficult, frustrating. A decision was made to reword the 'attitude ' questions in the newly developed scale.

The third factor extracted was classified as 'usefulness' and accounted for 9.53% of the variance. By consideration given to the PCA and coefficients alphas a decision was made to drop 3 of the items from the original 6 items that measured usefulness. This produced a coefficient alpha for the new 3-item factor of .6884.

The fourth factor extracted was classified as 'time pressure' (time pressure refers to a perceived pressure from others) and accounted for 8.94% of the variance. By consideration given to the PCA and coefficients alphas a decision was made to drop 3 of the items from the original 6 items that measured time pressure. This produced a coefficient alpha for the new 3-item factor of .7176.

The fifth factor extracted was classified as 'social interaction' (social interaction refers to being with other people) and accounted for 6.70% of the variance. By consideration given to the PCA and coefficients alphas a decision was made to drop 1 item from the original 3 items that measured social interaction. This produced a coefficient alpha for the new 2-item factor of .5184.

The sixth factor extracted was classified as 'intention' (intention refers to thinking or planning to do something) and accounted for 6.50% of the variance. By consideration given to the PCA and coefficients alphas a decision was made to drop 1 item from the original 3 items that measured intention. This produced a coefficient alpha for the new 2-item factor of .5510.

The newly constructed 24-item questionnaire included 3 questions related to each of the following factors privacy, safety, space, time pressure, usefulness and ease of use. The 24 item shortened version produced a coefficient alpha of .8396 (the reliability outputs can be found in Appendix C). Categories such as social interaction, attitude and intention had 2 questions related to each factor. The coefficient alpha for the attitude statements was .7743. Demographic characteristics recorded were: age, sex, country of residence and level of educational achievement. The final statements are listed below in their respective category (an example of the Internet survey can be found in Appendix C):

Social Requisites:

Privacy:

Other people can see what I'm doing when I am using a/an __________.

I feel as if other people watch me when I use a/an __________.

When I use a/an _________ the only time I feel I have enough privacy is when no one else is around.

Personal Space:

When I am using a/an __________ I feel other people don't give me enough space.

I feel uncomfortable using a/an _________ if there is someone queuing/waiting behind me.

I believe there is generally enough space around me when I use a/an ___________.

Safety:

I feel at risk if I spend too much time using a/an __________.

I feel vulnerable when using a/an ___________.

When I use a/an __________ other people's behaviour nearby makes me nervous.

Time Pressure:

When there is a queue (*or in a crowded place*) you have to hurry when using a/an___________.

I feel you can only undertake one activity on a/an ___________ if there is a queue (*or in a crowd*).

I feel have to spend less time using a/an ___________if other people are around.

Usefulness:

I would like to use _________ to do other activities/transactions.

I believe ___________ should only be used for banking purposes (*or emergencies*).

I believe more functions on a/an __________ would be helpful.

Ease of Use:

I find ____________ easy to use.

I find using __________ frustrating.

Learning how to use a/an _____________ is difficult for me.

Social Interaction:

When I use a/an I deliberately avoid contact with other people.

I avoid looking directly at a/an _________ user.

Attitude:

All things considered, I find ___________ an effective public resource.

All things considered, I find ___________ provide a poor service.

Intention:

I intend to use a/an ________ in the next week to (e.g. withdraw cash from my account, telephone a friend).

I intend to use a/an ________ in the next week to (e.g. check my account balance, access a number on my telephone).

7.3.2 Procedure

The survey was placed on the Planetsave.com website and asked for volunteers to complete a short survey with regard to technology use in public areas. All participants were chosen by purposive sampling. The form asked participants to complete only one questionnaire related to either use of ATMs, PIKs, Internet cafés or mobile telephones. A full explanation of the survey and instructions on how to complete the questionnaire were included on the first page. Participants also read a consent form, without clicking the 'I agree' button participants could not proceed further. Participants were asked to read and respond to all questions related to technology use by recording their responses on a continuum bipolar scale of 1-7. After completion participants were thanked for their contribution. Participants' answers to the individual differences statements were recorded by a true or false response.

Prior to further analysis all variables were examined through SPSS programs for accuracy of data entry, missing values, fit between their distributions and the assumptions of multivariate analysis. A total of 577 questionnaires were fully completed and used for further analysis: 294 for ATM use, 242 for mobile telephone use. As responses to PIK and Internet Cafés were very low (12 and 20 respectively) no further analysis for these technologies was carried out.

7.4 ATM use – study 1: Participants

Two hundred and ninety-four participants from various countries completed the Internet survey related to ATM use. 204 males, 83 females, 7 participants did not record their sex. The following tables show the demographic variables for this study.

Age Range	Frequency	%
16-25	30	10.2
26-35	87	29.7
36-45	75	25.6
46-55	56	19.1
56-65	37	12.6
65+	8	2.7
Missing	1	.3

Table 7.2: Age range of participants.

Country	Frequency	%
UK	82	27.9
USA	184	62.6
Australia	6	2.0
Canada	11	3.74
Other	11	3.74

Table 7.3:Particpants country of residence.

Education Level	Frequency	%
Primary or grade school	0	0
High/Secondary School or equivalent	22	7.5
Vocational/Technical School/College	11	3.7
Some College/University	68	23.1
College/University Graduate	76	25.8
Some Postgraduate Education	36	12.2
Postgraduate or Professional Degree	62	21.2
Other	2	0.6
Missing	17	5.8

Table 7.4:Participant levels of education.

7.4.1 Study 1: ATM use – results

SEM was used to analyse the data using EQS software (the SEM output related to ATM use can be found in Appendix C). Maximum likelihood estimation was used to find how the measured external variables fit in relation to TAMPS. Post hoc modifications were performed in an attempt to develop a better fit and more parsimonious model. On the basis of the Wald test several paths were deleted where it made theoretical sense to do so i.e. usefulness and attitude, space and intention, space and attitude. The model provided an extremely good fit to the data, Chisquare = 3.81, DF = 4, p = .43; CFI = 1.00; RMSEA = 0.00. Figure 7.1 provides a schematic depiction of the model fit and significant relationships between several of the independent variables.

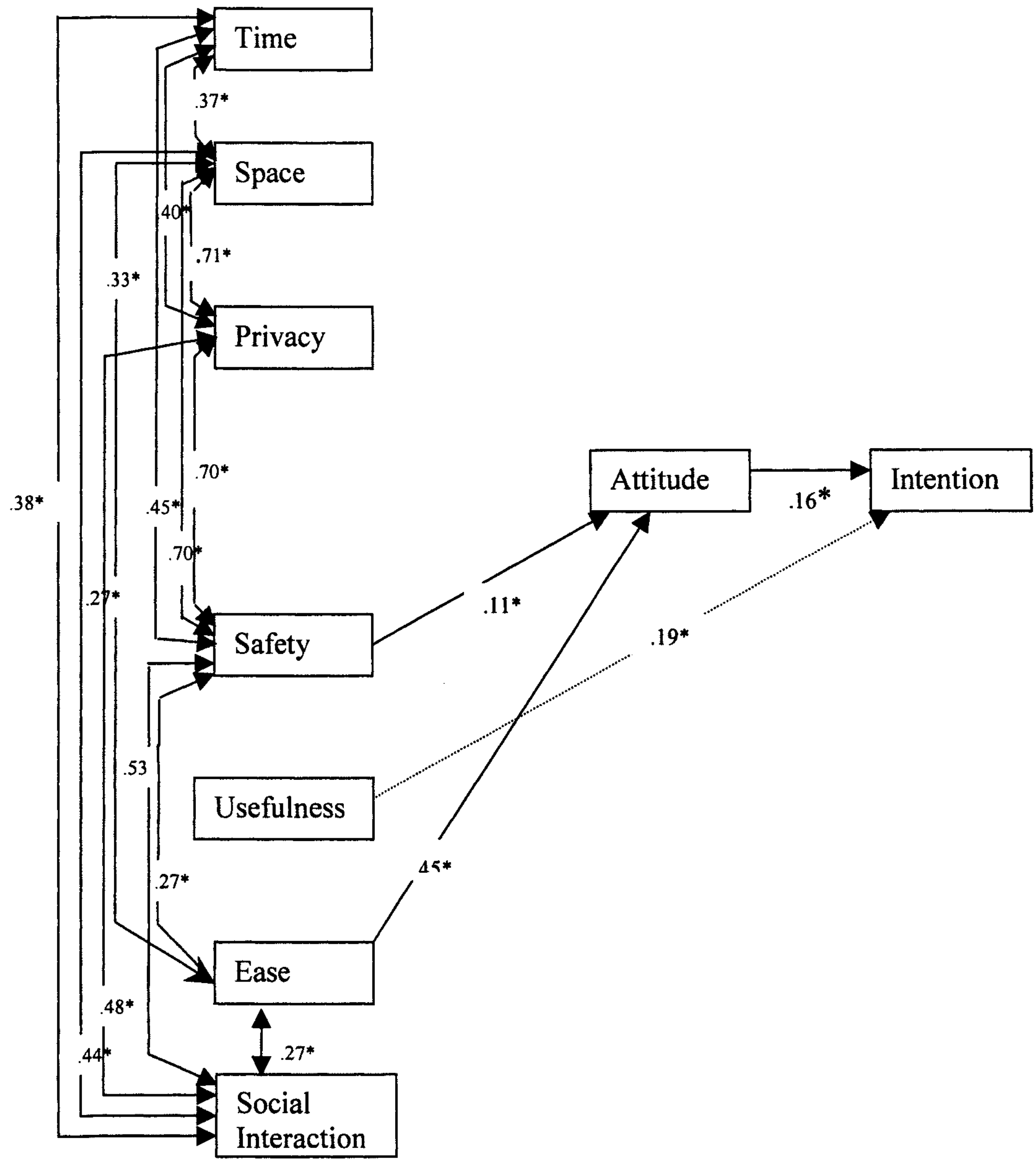

Figure 7.1: Model of factors that influence Attitude and Intention to use an ATM

The model provides evidence that Safety (.11) and Ease of Use (.45) are both predictive of Attitude towards the use of an ATM. The model also suggests that Usefulness (.19) is directly related to Intention to Use an ATM.

7.4.2 Summary of findings related to ATM use

The results from this study only partly support the previous findings reported in chapter 6. The previous study reported in chapter 6 found external variables such as privacy had a direct effect on attitude towards use of an ATM. The findings do support the original TAM in that usefulness has a direct effect on intention to use a technological system. However unlike TAM ease of use has a direct effect on attitude towards system use and is not mediated through usefulness. The failure of the results in supporting the proposed TAMPS model may be related to the different samples used. The sample in the research reported in chapter 6 was from one area in the UK compared to the majority of participants in this study who stated they were from the USA. When considering placement of ATMs between the two cultures vast differences may exist. ATMs in the USA are often located in spacious shopping malls therefore users' concerns over privacy and safety reduced. This is discussed further later in this chapter.

The attitude construct was dropped from TAM as Davis et al (1989) postulated that intention to use a system was the best predictor of use. These findings provide evidence that attitude is an important measure that accounts for user perceptions of how easy a system is to use. If their attitude is positive this in turn through intention will lead to actual use. Therefore ignoring attitude as in TAM does not account for all external variables that actually influence use. Consider this scenario, a user intends to use an ATM (positive intention) however when he approaches the system there is a large queue and he is in a hurry and does not want to wait. Only having knowledge about his intention we would assume he would use the ATM however taking into account other external variable changes the outcome. Therefore consideration must be given to the context of the interaction and the influence external variables have on a users actual intention.

7.5 Mobile telephone use – study 2: Participants

Two hundred and forty-two participants from various countries completed the Internet survey related to mobile telephone use. 172 males, 65 females, 5 participants did not record their sex. The following tables show the demographic variables for this study.

Age Range	**Frequency**	**%**
16-25	60	24.8
26-35	56	23.1
36-45	38	15.7
46-55	57	23.6
56-65	26	16.7
65+	4	1.7
Missing	1	.4

Table 7.5: Age range of participants

Country	**Frequency**	**%**
UK	82	33.9
USA	132	54.5
Australia	9	3.7
Canada	4	1.7
Other	13	5.2

Table 7.6:Particpants country of residence.

Education Level	Frequency	%
Primary or grade school	2	.8
High/Secondary School or equivalent	22	9.1
Vocational/Technical School/College	10	4.1
Some College/University	66	27.3
College/University Graduate	67	27.7
Some Postgraduate Education	21	8.7
Postgraduate or Professional Degree	38	15.7
Other	4	1.7
Missing	12	5.0

Table 7.7:Participant levels of education

7.5.1 Study 2: mobile telephone use – results

SEM was used to analyse the data using EQS software (the SEM output related to mobile telephone use can be found in Appendix C). Maximum likelihood estimation was used to find how the measured external variables fit in relation to TAMPS. Post hoc modifications were performed in an attempt to develop a better fit and more parsimonious model. On the basis of the Larange Multiplier and the Wald tests several paths were added or deleted where it made theoretical sense to do so. A path between intention and safety was added and paths between intention and space, attitude and time, social interaction and attitude deleted. The model provided an extremely good fit to the data, Chisquare = 5.51, DF = 4, p = .24; CFI = 1.00; RMSEA = 0.04. Figure 7.2 provides a schematic depiction of the model fit and significant relationships between several of the independent variables for mobile telephone use.

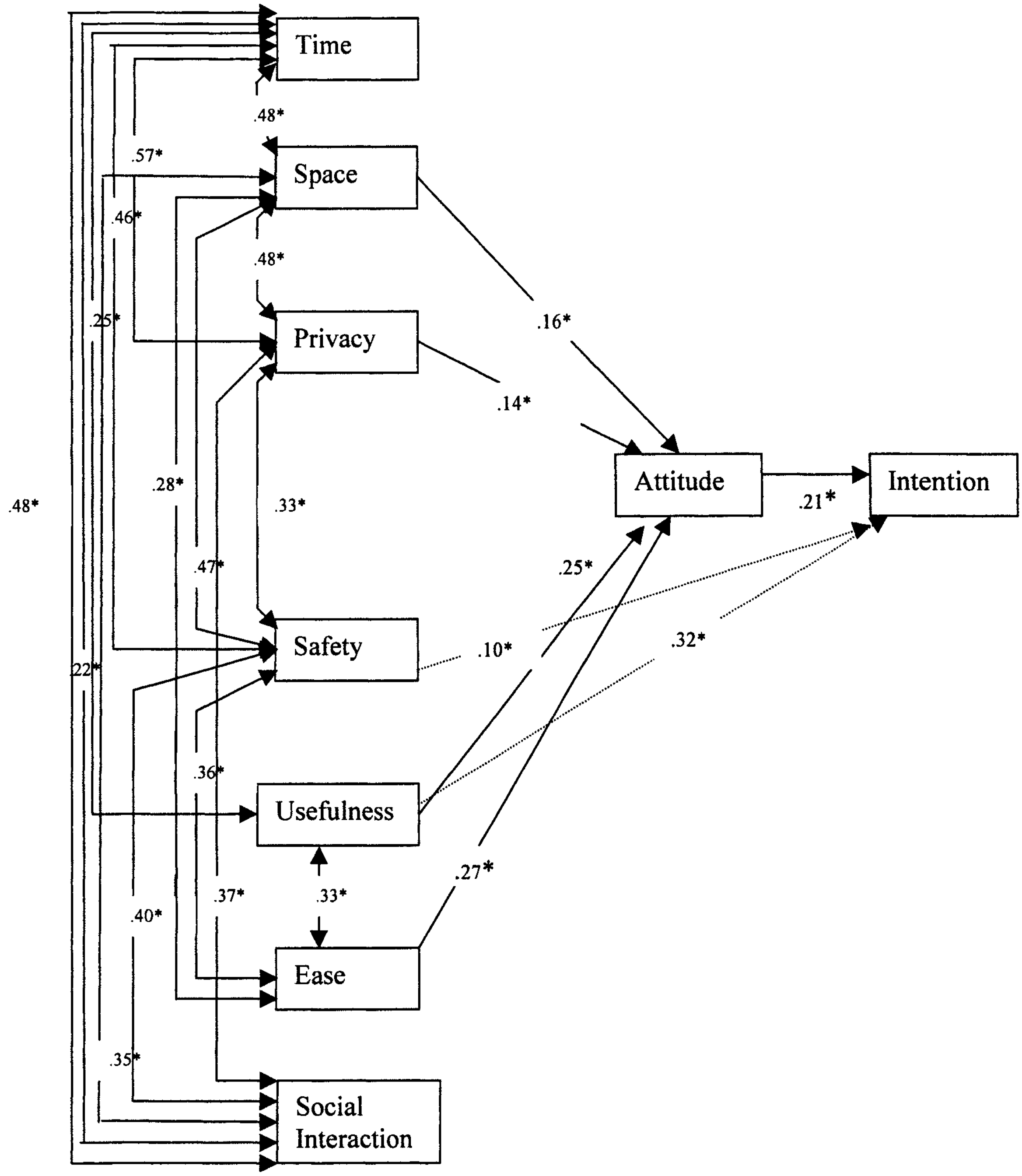

Figure 7.2: Model of factors that influence Attitude and Intention to use a mobile telephone

The model provides evidence that Space (.16), Privacy (.14), Usefulness (.25) and Ease of Use (.27) are all predictive of attitude towards the use of a mobile telephone. The model also suggests that Usefulness (.27) and Safety (.10) are directly related to Intention to Use a mobile telephone.

7.6.3 Summary

This study has provided empirical and important evidence that external variables have a direct effect on attitude towards use of a mobile telephone in a public area, as well as on intention to use such a system. The findings show perceived levels of privacy, space, safety, ease of use and usefulness affect the level of use of a mobile telephone. These findings support TAMPS in that external variables such as privacy and space have a direct effect on users attitudes towards technology use in public places. Also the findings appear to support the original TAM in ease of use is correlated with usefulness and may act as a mediator on system use through attitude. TAM posits that PU and PEOU have a direct effect on intention to use a system; the findings in this study do not support this view.

This study supports previous work by Lucas & Spitler (1999) in that external variables are an important influence on technological adoption and use. The study posits that the main variables included in TAM (PU and PEOU) are not the only major determinants of mobile telephone use. The TAMPS proposed in chapter 6 and again in this study demonstrates how external variables such as personal space, privacy and safety have a direct effect on attitude and intention to use a technology. Therefore mechanisms that determine user behaviour of technological systems in public areas such as a mobile telephone are more complex than stated in TAM. Therefore TAMPS is a more parsimonious model for understanding adoption and use of public space technologies.

7.7 Individual differences and technology use

An individual's personality is considered to be relatively stable over time compared to other emotional states e.g. mood. Personality consists of various traits that are classed as broad and enduring characteristics. As personality differs between individuals we can draw inferences about which type or trait they appear to have from their external behaviour (Eysenck 1998). Therefore if personality is stable over time and personality determines individuals' behaviour, we can assume consistency in behaviour on different occasions. Although a debate does exist with regard to whether personality traits are in fact stable over time, can successfully predict behaviour or if an individual's behaviour is governed by situational factors. This thesis supports the view that individual differences and situational constraints are both important in understanding behaviour in any given context.

With the rise in ubiquitous computing and tracking devices it is important to find how individual differences will affect use of such systems. There exists a vast amount of research that has measured individual differences and technology use e.g. self-efficacy (Compeau, Higgins & Huff 1999), openness (Anthony, Clarke & Anderson 2000), anxiety (Moston 1996). Zweig & Webster (2003) found introverts were less likely to use an electronic monitoring system in the workplace compared to extroverts. Computer anxiety is another trait well documented in the information technology (IT) literature (e.g.

DeYoung & Spence 2004; Beckers & Schmidt 2001). Negative emotional states such as anxiety are associated with failure to use new technologies (Moston 1996). Several computer attitude scales already exist that measure anxiety (e.g. Loyd & Gressard 1984, Nickell & Pinto 1986). To date there exists no measure of individual differences when related to technology use in public areas.

When considering individual differences and technology use in public places several traits need to be considered. Levels of anxiety are important especially when related to devices where users are receiving personal information. Empathy, tolerance, openness, dominance, sociability and co-cooperativeness may all be implicated in how users of systems behave. For example, someone who is more empathetic and tolerant may perceive waiting in a queue to use a system no problem compared to someone else who has low empathy and tolerance. Individuals who are high in extroversion and novelty seeking behaviours may not consider problems such as lack of space as major issues. Finding how individual differences affect technology use is important for both current and future applications.

7.7.1 Exploring individual differences

The most common way to assess personality is through a self-report questionnaire. A forced choice response on personality questionnaires is considered to reduce social desirability. This study employed such a method. Established personality questionnaires were examined for traits that could be specifically related to technology use. As this study was exploratory and no existing questionnaire covered all traits and their underlying dimensions of interest nine traits were chosen from four sources. Questions were drawn from the following existing personality measures and altered where appropriate to fit with technology use: Jackson Personality Inventory (Jackson 1994), Eysenck Personality Questionnaire–R (Eysenck & Eysenck 1991), The Personality Inventory (Bernreuter 1958), 16 PF (Cattell 1995). These nine traits were deemed appropriate when considering human interaction with technology in public areas. The questionnaire consisted of twenty-seven statements related to the nine personality traits. The nine traits consisted of: extroversion, dominance, empathy, social interaction, openness, co-cooperativeness, tolerance, anxiety and novelty seeking (an example of the Internet survey related to Individual Differences can be found in Appendix C).

These traits where considered important when considering human interaction with technology in public areas for various reasons. For example, anxiety is linked to an individual's negative emotional reaction commonly associated with failure when using a technological device (Anthony, Clarke & Anderson 2000). Table 7.8 provides an overview of the nine traits measured in this study and reason behind that choice.

Trait	Reason for choice
Extroversion	The more extroverted the person the more they will enjoy using technology in public places e.g. mobile telephones
Empathy Co-cooperativeness Tolerance Sociability	Individuals high in these traits will respond in various situations in an understanding way. For example, waiting in queues will not be problematic
Novelty Seeking Openness	Individuals high in these traits will find technology easy to use and show interest in the device
Anxiety	Linked with failure of technology use and social pressure from others
Dominance	The more dominant a person the more they will perceive certain situations as problematic e.g. having to wait for others to use a device or would encroach on the users space.

Table 7.8: Nine personality traits measured and reason for choice

The following statements were used in the individual differences questionnaire these were randomized on the actual survey. All questions were forced choice and participants answered using a true/false response. The questions are listed in their respective categories.

Novelty Seeking:

1. I am a fairly adventurous person

2. I enjoy new challenges and experiences

3. I do not like change in my usual routine.

Empathy:

4. When people make mistakes I find it easy to sympathize with them.

5. I easily become involved in other peoples problems.

6. People should deal with their own troubles and not seek help from others

Anxiety:

7. I frequently worry over trivial things. (Trait anxiety)

8. I am a relaxed, easy-going person. (Trait anxiety)

9. I feel uncomfortable in crowded situations. (State anxiety)

Tolerance:

10. I easily get irritated.

11. I am a very patient person.

12. It would not bother me if I had to wait in a queue.

Extroversion:

13. I do not like being the centre of attention.

14. I find it easy to talk to strangers.

15. I always feel self-conscious when I meet new people.

Co-cooperativeness:

16. I value other people's opinions.

17. I enjoy co-operating with others.

18. I prefer to work as part of a team.

Dominance:

19. I am good at organizing other people.

20. I would not take advantage of someone to benefit my own needs.

21. I would rather lead a group than follow it.

Social Interaction:

22. When paying for something I would rather use a machine than interact with another human.

23. I prefer to be alone.

24. I believe I am a sociable person.

Openness:

25. It takes people a long time to get to know me.

26. Other people can always tell when I am sad.

27. If I have a problem I find it easy to confide in my friends.

7.7.2 Establishing reliability and validity

A Principle Components Analysis was applied to the individual differences questionnaire to check for reliability and validity (the principle components output related to Individual

Differences can be found in Appendix D). On the basis of the scree-plot analysis and factor interpretability, seven main factors were extracted. They accounted for 50% of the total variance and each had an eigenvalue index greater than 1.0. The interpretation of the factors was based on the grouping of variables from the original questionnaire. The rotated factor matrix is reported in Table 7.9.

Question	**Extroversion**	**Tolerance**	**Novelty Seeking**	**Empathy**	**Social interaction**	**Anxiety**	**Dominance**
1			.735				
2			.692				
3			.644				
4						.694	
5		.461		.361			
6				.635			
7	-.594						
8						.656	
9		-.360			-.353	.302	
10		.701					
11		.802					
12		.626					
13	.481						
14	.623						.310
15	.689						
16				.698			
17				.427	.463		
18					.679		
19		-.368					
20							.728
21							.740
22					.433		
23					.592		
24	.389		.387				
25	.541						
26				.383			
27						.446	

Table 7.9: Rotated factor Matrix (Coefficients lower than .3 have been omitted).

The first factor extracted was classified as 'extroversion' and accounted for 16.67% of the total variance. This factor includes trait measures that were originally classed as extroversion, openness and social interaction. This is understandable, as on further inspection of the questions they all appeared to relate to being high in sociability therefore extroversion. Original coefficient alphas for the three individual concepts were: extroversion (.5433), openness (.3961) and social interaction (.4643). Grouping these five items revealed an alpha of .6350, further evidence that these variables were measuring the same construct.

The second factor extracted was classified as 'tolerance' and accounted for 8.81% of the total variance. The PCA revealed along with the original three questions related to tolerance one question associated with empathy was included in this factor. As the original coefficient alpha for tolerance was .6626 by adding the additional question alpha was reduced to .6399. Therefore only the three original questions related to tolerance were retained in this group.

The third factor extracted was classified as 'novelty seeking' and accounted for 7.3% of the variance. By consideration given to the PCA and coefficients alphas a decision was made to drop the openness question. This produced a coefficient alpha for the new 3-item factor of .6036.

The fourth factor extracted was classified as 'empathy' and accounted for 4.68% of the variance. This included two original questions related to empathy, one related to co-

cooperativeness and one to openness. This produced a coefficient alpha for the new 2-item factor of .4084.

The fifth factor extracted was classified as 'social interaction' and accounted for 4.46% of the variance. This factor included two questions originally related to social interaction and two related to co-cooperativeness. This produced a coefficient alpha for the new 4-item factor of .5281.

The sixth factor extracted was classified as 'anxiety' and accounted for 4.27% of the variance. This included the original two questions related to anxiety, one related to empathy and one related to openness. This produced a coefficient alpha for the new 4-item factor of .4539. . However no differentiation can be made between whether anxiety is trait or state related. This is reflected in one trait and one state anxiety question included in this construct.

The seventh factor extracted was classified as 'dominance' and accounted for 3.85% of the variance. This included two original questions related to dominance and one question related to extroversion. This produced a coefficient alpha for the new 3-item factor of .5976.

Although the coefficients alphas are below the accepted .70 as this is exploratory it was considered appropriate to include all the factors in subsequent analysis. The overall alpha for the questionnaire was .6311 (all reliability outputs related to the Individual Differences questionnaire can be found in Appendix D).

7.7.3 Individual Differences and ATM use

Several stepwise regressions were performed between attitude towards use of an ATM, privacy, space, safety ease of use, usefulness, time and social interaction as the dependent variables and extroversion, dominance, empathy, social interaction, tolerance, anxiety and novelty seeking as the independent variables (the stepwise regression outputs related to Individual Differences and ATM use can be found in Appendix D). The findings of only the significant variables are depicted in Table 7.10.

ATM	Trait	R (Pearson)	r^2	F	P
Attitude	Novelty Seeking	.12	.02	4.472	.035
Intention	Empathy	-.26	.07	20.994	.001
Ease of Use	Social Interaction Anxiety	.13 .12	.03	4.676	.010
Privacy	Anxiety	.19	.04	10.611	.001
Space	Anxiety	.20	.04	12.170	.001
Safety	Anxiety	.29	.08	24.534	.001
Time	Anxiety	.19	.04	10.662	.001
Social Interaction	Anxiety	.13	.02	5.099	.025

Table 7.10: Stepwise regression results for ATM use and related personality traits

Although exploratory some interesting findings have emerged from the analysis that warrant further investigation. Firstly the amount of variance accounted is low therefore results should be approached tentatively. ATM use is related to the levels of anxiety of the user whether this is state of trait based needs further investigation. However, this finding does support previous research (e.g. Moston 1996) in that anxiety is a major influence on technology use. As perceptions of privacy, space, safety, time pressure, social interaction and the ease to use increase so do users levels of anxiety. For example as perceived time pressure increases so do levels of anxiety that could be either trait or state based. However as anxiety increases so do perceptions of privacy, space and safety this appears opposite to what one would predict. The findings may suggest that when more space is available this increases a user's levels of anxiety. This finding supports previous research outlined in chapter 6 that ATMs can often be located in environments that are too open.

The trait 'social interaction' contributed significantly towards user perception of how easy an ATM is to use. This is interesting, as the more sociable an individual, this appears to increase perceptions of how easy a system is to use. Findings in this study also indicate individuals with positive attitudes towards ATMs are higher in novelty seeking behaviour. Intention to use an ATM appears to be associated with the users levels of empathy, however in this case negatively. Therefore the less empathetic a person the higher his or her intention to use an ATM. This is interesting, as individuals with less empathy may take longer to use an ATM even when other people are waiting to use the system compared to someone high in empathy. The less empathetic person may focus on his or her need and not give consideration to other people waiting.

7.7.5 Individual differences and mobile telephone use

Several stepwise regressions were performed between attitude towards use of a mobile telephone, privacy, space, safety, ease of use, usefulness, time and social interaction as the dependent variables and extroversion, dominance, empathy, social interaction, tolerance, anxiety and novelty seeking as the independent variables (the stepwise regression outputs related to Individual Differences and mobile telephone use can be found in Appendix D). The findings of only the significant variables are depicted in Table 7.11.

Mobile Tel.	Trait	R (Pearson)	r^2	F	P
Attitude	Extroversion Tolerance	-.22 -.11	.07	8.716	.001
Intention	Empathy Anxiety Dominance	-.32 -.17 -.16	.16	14.590	.001
Ease of Use	Extroversion	-.15.	.02	5.476	.020
Usefulness	Empathy	-.21	.05	11.427	.001
Privacy	Extroversion	-.18	.03	7.669	.006
Space	Extroversion	-.25	.06	15.803	.001
Safety	Extroversion Anxiety	-.29 .15	.11	14.236	.001
Time	Extroversion	-.14	.02	4.860	.028
Social Interaction	Extroversion Anxiety	.21 .17	.07	9.047	.001

Table 7.11: Stepwise regression results for Mobile Telephone use and related personality traits

7.7.5 Summary of individual differences and mobile telephone use

As mentioned earlier as this study is exploratory the results should be approached tentatively. However they do highlight some interesting findings that warrant further investigation. Anxiety again emerged as a major personality trait that is related to technology use in this case a mobile telephone. However no inference can be made as to whether anxiety in this respect is trait or state based. External variables such as safety and social interaction are positively correlated with levels of anxiety. Again this may indicate using a mobile telephone when alone in public places decreases perceived levels of safety. Intention to use a mobile phone is negatively related to levels of anxiety. Extroversion emerged as a major personality trait that is negatively related to user attitude and their perceptions of how easy a mobile telephone is to use and perceived levels of privacy, space and safety. This finding indicates introverts appear to have more positive attitudes towards mobile telephones compared to extroverts. Also the less extroverted a user appears to be is associated with higher levels of perceived privacy, space and safety. Extroversion is positively related to social interaction that is well documented in the personality literature. Intention to use and how useful a mobile telephone is considered to be is negatively correlated with the trait empathy. Individual's attitudes appear to be negatively related to tolerance. Intention to use a mobile telephone is negatively correlated with the trait dominance.

7.7.6 Considering the importance of individual differences

Although emphasis has been made on the exploratory nature of this research and results need to be approached carefully findings do highlight some interesting phenomena that need further investigation. Developing a valid psychometric tool that measures individual differences and technology use in public places is an important area that warrants further work. However it is not in the scope of this thesis to undertake such an investigation.

When considering future devices where user profiles will be used to develop personalized systems knowledge of the differences between individuals is therefore very important. For example, person A is extroverted and of a tolerant disposition, company B sends an audio message to his mobile device that a fantastic party is taking place next week but in order to get a ticket he must queue now. Person A is thrilled with the invitation and goes off to queue. Imagine person B introverted and less tolerant receives the same audio message while talking to a friend, this person dislikes parties, he is annoyed and embarrassed at receiving the information and in this particular context. Therefore it would be advantageous for developers and service providers to know the personality of their users and develop matching profiles. Already companies exist e.g. The Register where users can set up personalized profiles for an annual fee. The system 'learns' about the users interests and prioritizes the information they receive (Cullen 2004).

7.8 The Internet as a viable research tool

As discussed earlier the Internet has been criticized as an unreliable research tool. One of the main criticisms is the bias that occurs through sampling. The majority of participants in this study were from the USA (58.5%) and stated they had undertaken some college education. However the age range of participants was broad i.e. ranging from 16 to 65+ years. Therefore there does appear to be a slight bias in sampling in this study. This may be the reason why results related to ATM use do not fully support previous ones stated in chapter 6. The majority of participants were from the USA; perhaps locations of ATMs differ greatly from the UK. America is known to have ATMs located in spacious shopping malls and drive through ones are common. In retrospect the results reported here might in fact be a truer reflection of the factors that influence ATM use. The original sample reported in the previous study was from one city in the UK highlighting the Internet survey might be more representative of the normal population. Therefore when considering use of ATMs in different countries or cultures it would be advantageous to record where the ATM was actually located and obtain a description of the surrounding area. As the survey carried out in this research was only in English this may be one limitation of the study.

Overall the Internet survey carried out in this study has proved to be a reliable and valid one. Coefficient alphas were found to be high when measuring technology use via the questionnaire: .8520 for ATM use and .8493 for mobile telephone use. The mean response to all questions varied little between the UK and USA populations and was similar to the study reported in chapter 6. This indicates no discrepancy between the Internet survey and the original paper one. This supports previous research by Buchanan & Smith (1999) as both sets of data displayed the same psychometric properties. The findings from this study are evidence that the Internet is a reliable, robust tool that can be used successfully in research.

7.9 Discussion

The 24-item questionnaire has proved a successful, useful, practical and reliable tool. The development of the questionnaire was focused on public space technologies, with the realization that future systems will be more ubiquitous. As systems begin to be more ubiquitous and embedded in our daily lives measurements are needed to ascertain what will influence use and the user. The questionnaire has been applied successfully to measure factors such as privacy and space that influence use of both mobile and static public systems. The psychometric tool devised in this thesis has integrated socio-environmental and usability factors in order to understand what influences use of public space systems. If designers are to be successful in evaluating or facilitating adoption and use of ubiquitous and mobile systems then they need to use such a tool as the one developed here.

TAM has been successfully applied to specific areas of research such as technology adoption in the workplace (see Davis 1989). However, the findings from this study and the previous findings in chapter 6 suggest that when applying TAM to explain user behaviour or adoption of technological systems in public areas new and/or expanded theoretical models are needed such as the TAMPS model proposed in this thesis. The findings have highlighted the importance that systems used in public places need to be easy to use. In the previous study as well as this perceived ease of use has again emerged as a major predictor of attitude towards use. Therefore this variable is important and needs to be incorporated in all future research. Fully understanding use can help to identify barriers and problems faced by users and in turn further educate designers and service providers of systems.

7.9.1 Emergence of context

When considering human interaction with systems found in public areas consideration needs to be given to the user population, their characteristics, what task the system will be used for, the actual environment and the location. In this research personality (user characteristics) has surfaced as a major influence on adoption and use of technologies, this is one area that requires further research. Another important issue is the type of task or transaction the user will be using the system for. Frequently new systems are installed or used in public areas to access a variety of different information. Many public systems require the user to enter personal and private information such as a personal identification number (PIN) such as that needed to access financial information on an automated teller machine (ATM). Further research is needed in this area to help increase levels of privacy, personal space and safety for users of such systems. The findings from this study suggest that context is a key area that needs further investigation. Understanding contextual influences will help build a complete account of how problems arise for users of systems in public places. Therefore an in-depth investigation into just how context affects use of such systems is needed.

7.10 Chapter Summary

This study has provided important evidence that attitude and intention towards use of a technological system in a public area is influenced by socio-environmental perceptions of privacy, personal space and safety. The new 24-item questionnaire developed here provides a practical and socially sensitive tool for assessing and measuring attitudes to technological systems in public zones. The use of this tool for predicting acceptance and future use of ubiquitous systems is recommended.

As Hartson (1998) states a core theme in HCI is to objectively design, construct and evaluate computer-based interactive systems. Good design therefore needs to consider the importance of both socio-environmental and usability factors on technological systems that are used in public areas. The future is ubiquitous; people will use technologies free from the constraints of time and place. It is up to the HCI community to design and place such systems so people can use them efficiently, effectively, safely and with satisfaction.

Chapter 8

Considering context

Previous research in this thesis has found socio-environmental factors influence the use of technology in public areas. A major determinant of use may well be the context the technology is used in. This chapter describes two studies that put context at the heart of the research agenda by using an activity theory approach. The findings from both studies enhance our understanding of those factors that influence technological use and result in a more comprehensive, global picture of those factors.

8 Introduction

A major determinant of use may well be the context a technology is used in. In recent years a growing number of studies in the HCI field have encompassed the fact that context has an important influence on adoption and use. Rogers & Scaife (1997) state that 'a person's behaviour is always part of a context that is wider than the individual'. This type of statement emphasises the importance of how both internal (e.g. an individual's conscious planning) and external factors (e.g. interaction with other people or technology) can influence an individual's behaviour.

Certain methods popular in HCI research – such as task analysis – are relatively insensitive to context, and fail to reveal just how an individual's goal or motive can be altered by contextual influences. Real life interactions take place in situated context not in laboratories (Suchman 1987); therefore it seems apparent that when considering HCI in public places an approach is needed that puts this context at the heart of the research agenda.

A conceptual framework that incorporates the importance of internal and external influences on human behaviour is 'Activity Theory' (AT). To date AT has been applied to various research areas in the HCI field (e.g. use of technology in higher education (Issroff & Scanlon 2002); work practises (Mwanza 2002); alarm telephone adoption (Hyppönen 1998).

8.1 Activity Theory

A core theme in AT is that an individual's actions are rooted in their socio-cultural context and therefore cannot be understood independently of it (Williams 2001). A central concept in AT is that an individual's internal activities (thoughts, emotions) and external activities (interaction with others or technology) can influence an individual's behaviour or their behavioural intention. The importance of internal/external processes in AT highlights the dual nature of human activity and that no boundaries exist between the two. One cannot fully understand internal activities without considering external activities.

AT considers that when an individual undertakes any form of activity, their behaviour is not just a simple reaction to surrounding factors that may influence it but is part of a whole mediation process that includes tools, rules and structure. All components within the system dynamically and continuously interact with other components, thus AT considers all of the components in an activity system not separately but in terms of the dynamic whole.

An important aspect of AT is understanding the historical development and use of tools that mediate a particular activity. This helps to understand how existing tools are used by people within their cultural setting (Mwanza 2002). AT acknowledges the fact that human activity is an active process that develops and re-develops along with any social and cultural changes that occur in that particular society.

8.1.1 Activity Process

Leontiev (1978) proposed that all activities are structured in a hierarchical way. At the bottom are operations that are routine behaviours that need little conscious effort. The next layer is that of actions which need conscious planning. The activity itself tops the structure. Activities correspond to an individual's motive, each motive is an 'object' that satisfies a need. Actions correspond to conscious goals that guide the activity and the operations are associated to the conditions needed to attain the goal (Leontiev 1978). Actions can turn into operations as they become more automated and vice versa. There is no strict segregation between action and activity; an activity can become an action if the motive changes. If individual's operations are hindered this will often go unnoticed and they will adjust to the new operation without much thought. When individuals' goals are hindered they need to know how to react and then set a new goal. However if individuals' motives are hindered they can become disturbed and their behaviour can be unpredictable. Leontiev stated that actions could only be understood through the collective activity of which they are part. Figure 8.1 provides a schematic depiction of Leontiev's activity process.

$$\begin{array}{ll} \textbf{Activity} & \textbf{Motive} \\ \updownarrow & \updownarrow \\ \textbf{Action} & \textbf{Objective} \\ \updownarrow & \updownarrow \\ \textbf{Operation} & \textbf{Condition} \end{array}$$

Figure 8.1: Leontiev's activity process

8.1.2 Activity process of ATM use

Figure 8.2 provides an example of user activity related to ATMs the hierarchal structure is based on previous research by Hyppönen (1998). The activity process shows how a person's motive (the need for money) would be structured within the system. For example, a person knows they need money to buy food; they use an ATM to withdraw money from their bank account. The person consciously plans which ATM to use, the user is experienced therefore knows how to use the machine and the actual process that is required to obtain money. The person goes to the machine puts in his or her card, taps in their personal identification number (PIN), and presses the button for the amount of cash they need, waits for the money to come out, collects their card and then goes off to buy food.

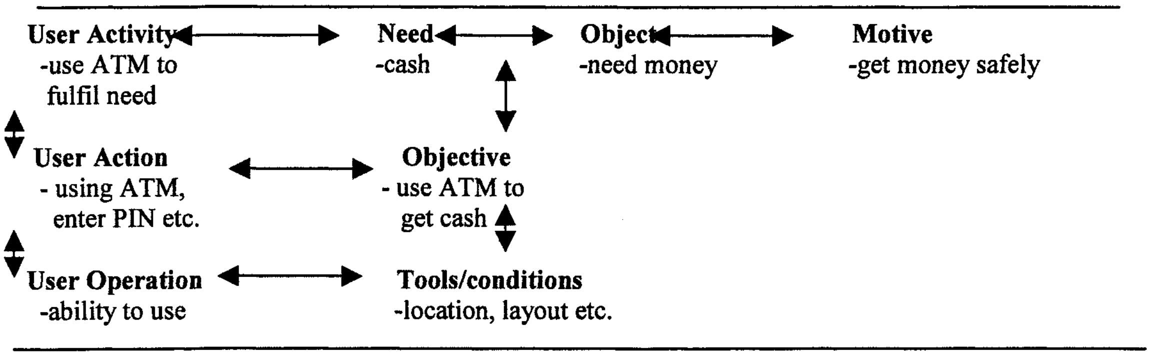

Figure 8.2: Hierarchal structure of ATM use

8.1.3 Engeström's approach to human activity

Vygotsky (1978) stated human interactions with their environment are mediated by the use of tools and signs. He proposed a basic mediation process: subject → tool → object. Engeström (1993; 1996; 1999) expanded Vygotsky's activity system to include all mediating artefacts that may influence an individual's activity, in particular the use of technology. The elements in the system illustrate the socially distributed nature of human activity. Figure 8.3 illustrates Engeström's model of human activity.

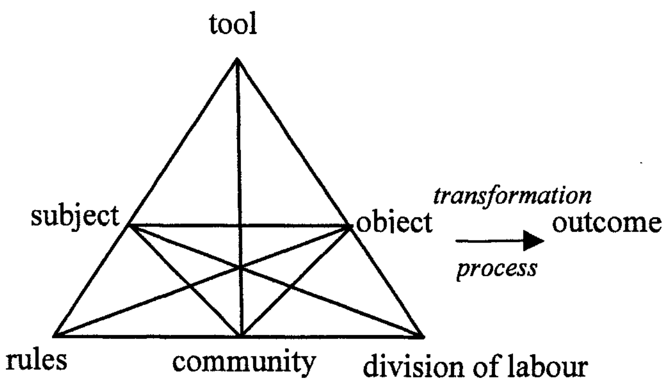

Figure 8.3: Engeström's Activity System Model (Engeström 1999)

The central theme in Engeström's activity system is the idea of contradictions or tensions that exist between or within the elements. In Engeström's model three mutual relationships exist subject, object and community. Subject and object are mediated by tools, subject and community are mediated by rules, subject and community are mediated by the division of labour. The subject is the person carrying out the activity, and the object is the target of the activity. The community refers to the immediate environment, other users and people in that particular vicinity. A tool can be anything that is used in the transformation process. Rules refer to the implicit/explicit norms and social convention within that particular community. The division of labour refers to implicit/explicit organisations, management's etc. associated with the system. All elements can influence the transformation process of the object into the outcome.

8.1.4 Limitations of AT

AT is normally used from a developmental perspective and applied to areas of research such as the design and implementation of new technologies within the HCI community. It is not generally used to assess problems that arise for users of existing technologies, however existing technologies change over time. The technological systems used in public areas are evolving rapidly. For example, as discussed in chapter one new capabilities in ATMs allow users to add airtime to their mobile telephones. and recent systems in public areas allow users to access sensitive health information. AT does, therefore, appear an appropriate methodology to use when considering technologies that are used in public areas and are affected by contextual change.

At present no clear guidelines or concrete methodological procedures exist as to how to apply AT in research or in fact analyse the data once gathered. Suggestions have been made that Engeström's framework is best suited for interviews, case studies, research that is carried out in the actual environment the activity occurs and over a period of time (Mwanza 2002).

8.1.5 Activity Theory and technology use in public areas

As AT emphasises the importance of context within activity systems it seems an appropriate step to apply AT to technology that is used in public areas. Previous findings in this thesis suggest several factors influence use of an ATM. By taking an AT approach this may further identify contradictions and problems an individual has when using an ATM in a public area. Figure 8.4 illustrates how Engeström's model can be applied to ATM use.

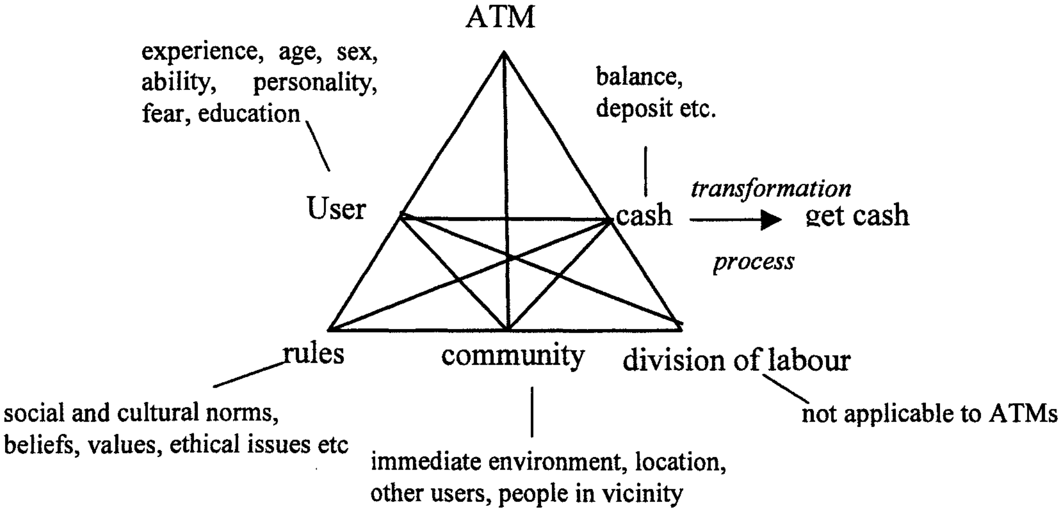

Figure 8.4: An individual activity system for ATM use

8.2 Aims

The research reported in this chapter used an AT approach to identify problems that exist for users of ATMs. Two qualitative studies are reported. The aim of the first study was to identify contextual problems that exist for users of ATMs. The aim of the second study was to further explore and verify contextual influences through focussed discussion groups with ATM users. Several key challenges are identified:

- To find how contextual factors influence use of ATMs through application of AT
- To find if the framework proposed by Engeström's can be successfully applied to existing technologies, in this case an ATM
- To explore the use of videotaped activity scenarios (VASc) in focussed discussion

- To use AT as a framework to elicit rules from ATM users through focussed discussion to help reduce if not eliminate problems they face
- Consider if AT can be expanded and used as a verification technique for previous qualitative data through the use of VASc

8.3 Method

An important premise in AT is the context a technology is used in (Nardi 1996). Therefore where the aim is to consider problems that exist and influence use of a technology in a public area AT appears to be a favourable approach to use. Using Engeström's framework to interpret the data in this study will give a full description of how contextual constraints influence ATM use. This in turn will highlight how the user is affected by both internal and external factors.

The central process in activity theory is to break down the data that has been obtained from the research, conceptualise it, resemble the data and look for contradictions or problems between the elements or mediating artefacts in the activity system. Finding contradictions generates the influences the different elements have on each other and therefore the user and their goal.

8.3.1 Participants

A total of twenty participants took part in the study, 14 females and 6 males using purposive sampling. The age range was from 17 to 52 years (mean 38.8 years). Participants were recruited from the general population in the Newcastle upon Tyne area of England. Participants stated they were either frequent or non-frequent ATM users.

8.3.2 Procedure

All participants were interviewed individually using an open-ended semi structured technique in their own homes. All interviews were tape recorded with prior consent of the participant. An interview guide was used so that all the related concepts from the activity theory checklist proposed by Bødker (1996) were included. The checklist involves concepts such as what, where, how, why. In this study the concepts related to ATM use (see table 8.1). The examples in table 8.1 were not asked in a formal way but provided a checklist that needed to be included in the interviews.

Artefact Class	Example of Characteristic
What	What did you do to achieve your goal?
Why	Why did you use that particular ATM? Why did you need too?
How	How did you carry out the activity?
Where	Where did this happen e.g. location?
When	When was that e.g. day, time?

Table 8.1: AT checklist related to ATM use.

Participants were asked to recall and fully describe two scenarios: the last time they used an ATM and another time that was different to the first description. Participants were asked to include in their descriptions when the activity took place, where, why, what happened and where they were going afterwards. Asking participants to give a detailed account of their activity helped build a conceptual description for each individual activity that was rich in emotional detail. 19 participants fully described two different scenarios of ATM use, 1 participant was only able to describe the last time due to the fact they rarely used them. Overall the interviews produced 39 different activity systems for ATM use. The duration of the interviews varied from 10 minutes to 45 minutes.

8.4 Analysis

All interviews were transcribed then read: a sentence-by-sentence analysis was employed for each of the 39 different activity systems. Contradictions between the elements in each activity system were highlighted. All 39 activities were then compared for similarity with regard to the problems that existed between the elements within each individual system. After comparison the systems were grouped into 12 different types all of which had the same problems within that particular system. The 12 activity systems ranged from no contradictions at all to several contradictions between the elements.

Generally when analysing activity theory contradictions are looked for between mediating artefacts e.g. the tool mediates the relationship between subject and object. This study did look for contradictions between the three mutual relationships that exist: subject, object and community, however the analysis also focused explicitly on the interaction between each of the elements e.g. subject (user) and tool (ATM). In the figures that follow thickened lines show where the problems emerged within each of the different systems. Also lightening bolts are used to highlight the fact several contradictions arose between the various elements.

8.5 Contradictions within each of the Activity Systems for ATM use

Activity system 1 (11 descriptions) revealed no contradictions within the system. Users stated that no problems arose between any of the elements within the activity system for ATM use. System 2 (1 description) revealed problems with mediation through the ATM (tool) between the user (subject) and the object elements. A problem was found between the user and the ATM as a wrong PIN was entered. Also problems arose between the ATM and the object due to glare from the sun on the ATM screen and the user not being able to get a receipt from the machine.

'One problem I did have was I couldn't see the screen due to the glare from the sun. It was a bit worrying as when you have put your card in the machine and then can't navigate through the options because you can't see them, even to try to get your card back'.

8.5.1 Activity system 3

System 3 (1 description) highlighted a problem with mediation through the ATM between the user (subject) and the object elements. A problem was found between the user and the ATM element as this participant was to busy talking to a companion that she did not realise she had already taken her card out of the machine. This user thought the machine had kept her card and went off to the bank to complain later realising the mistake.

8.5.2 Activity system 4

System 4 (1 description) revealed a problem with mediation through the community, user and object elements. The problems related to the fact that a car full of men pulled up when this user was in the middle of the activity (using the ATM). This made the user feel unsafe and therefore only carried out one transaction on the ATM when she wanted to do more. The fact it was 6.30 am, dark and there was no one else around added to this user's concerns.

'Then a car full of men pulled up, about four of them in the car obviously just going for their wages but I was just really nervous by this time as it was really dark so I felt really rushed trying to get my money out. I didn't even consider getting a balance or anything like that'.

8.5.3 Activity systems 5 and 6

System 5 (2 descriptions) revealed a problem between the user and community elements. One user had to wait to use the ATM while another user stated that cars pulling up at the ATM caused concern (see Figure 8.5).

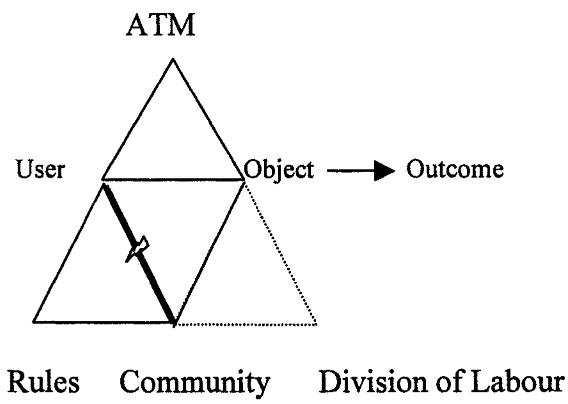

Figure 8.5: Activity System 5 of ATM use showing problems between user and community elements

System 6 (2 descriptions) highlighted problems between the user, community and tool elements (see Figure 8.6).

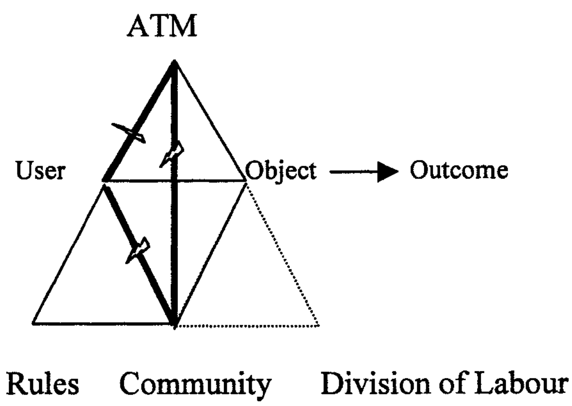

Figure 8.6: Activity System 6 of ATM use showing problems between user, tool and community elements

Problems arose between the user and the ATM as the actual design of the ATM was described as being too open plan and placed in an area that lacked space.

Contradictions between the user and the community revealed that problems arose from the actual area the ATM was located, users having to assess the area before use so they felt safe and actually having to move when using the machine to let other people by.

'It (the ATM) seems open plan, if you say a cash point can be open plan in terms of a keyboard'.

'Yeah, I had to move for people to get past (when using the ATM), it made me feel very uncomfortable, unsafe, I felt I didn't have enough privacy'.

8.5.4 Activity system 7

System 7 (7 descriptions) revealed problems with mediation through rules between the user and community elements (see Figure 8.7).

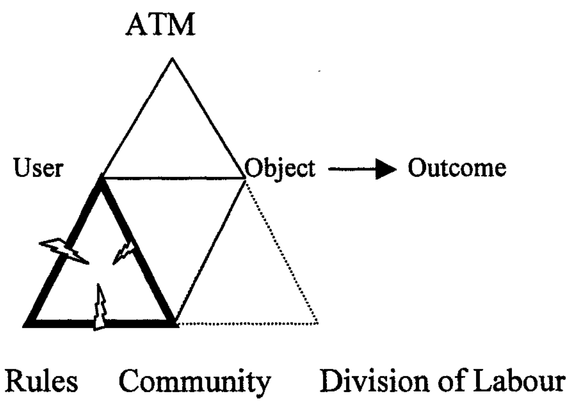

Figure 8.7: Activity System 7 of ATM use showing problems between user, rules and community elements

Problems arose between the user and the community due the actual environment the ATMs were located (e.g. outside busy supermarkets). Users described problems such as concern over the type of people around, the immediate vicinity being too crowded and they had to try to hide the machine as they felt other people in the area could see what they were doing. Users also described they felt rushed when other people were waiting. Other people in the area appeared not to abide by the accepted rules of behaviour as they encroached on the user's space thus reducing perceived levels of privacy and safety. One participant who was waiting to use the ATM actually stated they invaded the user's space as they were in a hurry.

' The cash point was not busy but there was one person in front of me who seemed to take a long time and that was irritating me a little bit as I only have so long for lunch. I felt as if I got too close to the person because I was impatient and I stepped back'.

'I felt I just had to be quick, very quick get my money and go, not just because the man was waiting but because of all the people walking past. It made me feel rushed. I had to use it but I don't like to use them when they're outside, in the open, you feel intimidated. I don't know why but I do.'

'You get a bit flustered (when using the ATM) because you think people can see what I'm doing, they're standing too close or oh god there's loads waiting here, that's how I feel if I'm using it'.

8.5.5 Activity system 8

System 8 (2 descriptions) revealed problems with mediation through rules between the user and community element within the system. Also contradictions between the user and the object emerged (see Figure 8.8).

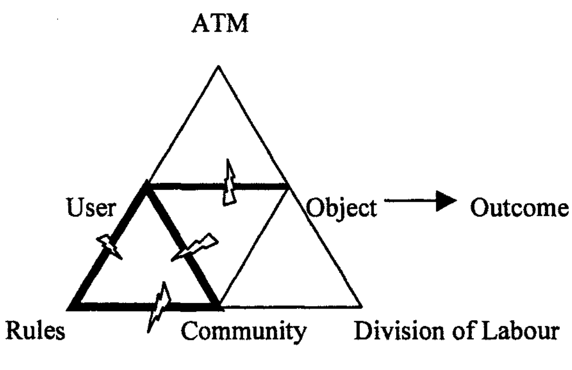

Figure 8. 8: Activity System 8 of ATM use showing problems between user, rules community and object elements

Problems arose due to the fact users did not have enough money in their account or the type of account only let them withdraw a certain amount of cash. Therefore the outcome of the activity was not what the user expected. Problems again emerged between the community, user and rules elements. Users felt they had to be more secretive when someone was using the machine next to them due the fact the area was busy and they thought other people could see personal information. Also, the fact the machine was located outside added to their concerns over privacy and safety.

'I didn't have any money in my account only £3, as I hadn't been paid'.

'I felt I had to be more secretive there (compares internal to external ATMs) than other places because it was outside and there were funny people around and they could have ran off with my money'.

8.5.6 Activity system 9

Activity system 9 (2 descriptions) highlighted contradictions between the user, community, rules, object and tools elements (see Figure 8.9).

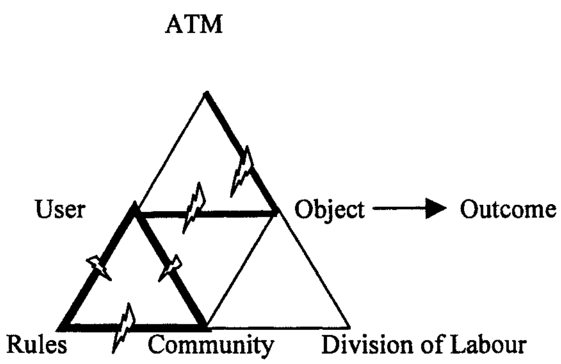

Figure 8.9: Activity System 9 of ATM use showing problems between user, rules community, object and tools elements

Contradictions arose between the user and the community due to a feeling of perceived pressure from other people waiting to use the ATM, the immediate vicinity being crowded and reduction in feelings of safety. Users perceived others waiting did not follow the accepted social norms of behaviour e.g. talking loudly to try to hurry the user. Problems occurred due to the machine not being able to provide receipts therefore this hindered the expected outcome.

'...sometimes you can't get a statement because the machine runs out of paper'.

'...a couple of women started raising their voices. I was aware of them anyway but I was waiting for my receipt because I had asked for one and then I realised it had ran out of paper so I'm not going to get one. So I was aware I was holding up the queue but really I wasn't I was just waiting for my receipt'.

'I don't feel happy because of all the people around; when there's lots of people around you think who's watching me. There's got to be someone around you keeping an eye on you, there could be two people together, working together. You know one gets your attention and you turn around and the other one whips your bag'.

8.5.7 Activity system 10

System 10 (4 descriptions) highlights contradictions between the user, tool, community and rules elements (se Figure 8.10).

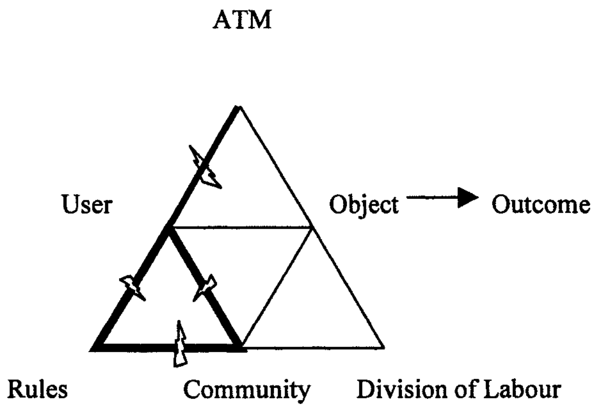

Figure 8.10: Activity System 10 of ATM use showing problems between user, rules community and tools elements

Problems in activity system 10 emerged between the user, community and rules due to the immediate vicinity being crowded, concerns over fraudulent scams related to ATMs and a perceived pressure from other people for the user to be quick. Again users also stated that other people encroached on their space thus reducing levels of privacy and safety. Users stated problems occurred due to their level of experience and familiarity with the type of ATM used.

'...it's the only machine I know how to use.....Some machines ask stupid questions and you've got to press more buttons'.

'Dead nervous, because I haven't used that machine before and it was much different to the one I normally use. I felt nervous going up to it and that all the kids were hanging about. I kept looking around all of the time, you're always looking out the corner of your eye'.

'I just make sure that someone's not standing to close behind me, that there's distance between me and the person. If there was a big queue I wouldn't join the queue I would wait for it to go down and them join it. So that you know, someone doesn't try anything on when you're standing in the queue'.

8.5.8 Activity system 11

Activity System 11 (5 descriptions) revealed problems between the user, community, rules, object and tool elements (see Figure 8.11).

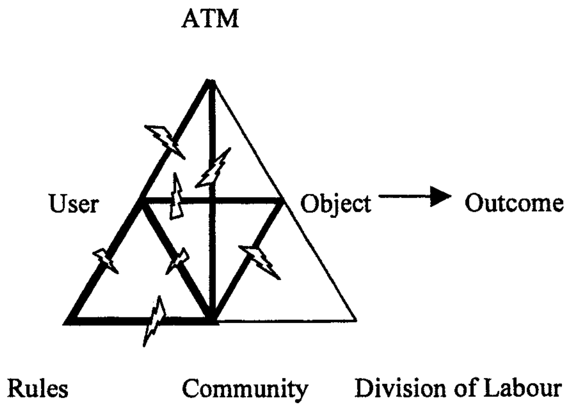

Figure 8.11: Activity System 11 of ATM use showing problems between user, rules community, object and tools elements.

Contradictions found in system 11 highlighted problems between the user and ATM elements such as there not being enough ATMs in the area, levels of experience and anxiety of the user. Contradictions between user, community and rules arose due to other people in the immediate vicinity or waiting to use the ATM encroaching on the users space. Therefore this reduced levels of privacy and safety. The behaviour of other people in the area also caused concern. Contradictions arose between the community element and the users goal (object) element as all users only carried out one transaction instead of two or more as users sensed they had to be quick so as not to keep others waiting. Users also perceived that other people came too close and therefore did not abide by the accepted social norms of giving the user an adequate amount of space. One user also commented that the area around one ATM located inside a shopping complex was not very well lit thus the area appeared less safe than other locations. Contradictions between the user, ATM and community elements emerged as users made mistakes entering their PIN, as they felt anxious because other people were waiting.

' When it was my turn next I remember thinking I didn't like it when people walked in front of me and the person using the machine, it made me feel uncomfortable even though I wasn't using it. When you are using it you can feel people walking past behind you, cutting in with their trolleys, going back to their cars, it makes you feel uncomfortable, unsafe. Even when I got my money I didn't bother with a receipt or anything because I felt uncomfortable '.

'They don't seem to have thought where is the best place for people to have privacy and get their money out. You don't know who's watching you and I don't like the idea someone could see my personal banking and I do like to know how much money is in my account. I don't like the idea someone can see how much money I've got or see my card, the numbers I press in, and it's too open (the ATM and location). I just like to feel safe and secure. It's a great service but there's nothing secure about it'.

'There's two (ATMs) at the very bottom (inside shopping complex) and I don't like it, it's very dark and they're right next to each other and there was a huge queue'.

' I was a bit wary of them (two people using the adjacent ATM) so I made my friend stand to the side so they couldn't see me and then I stood over the machine and covered the PIN over with my hand. That time I just drew the money out and went straight away because there were so many people waiting. I didn't want to take too

long because I felt, not nervous but rushed. So I just got the money out and left. People stand back about four feet but it's not very much and it feels as if they're on top of you, watching what you're doing. I check who's there first and if there's any funny people about I'll not use it'.

' I always feel nervous when I'm going to use one (an ATM), there weren't many people around but there were people standing at the telephone box, which put me off a bit. I used the cash point machine but I made a mistake I put in the wrong PIN I felt nervous because someone had come up behind me'.

8.5.9 Activity system 12

Activity system 12 (1 description) highlights contradictions between user, tool, object, community and rules (see Figure 8.12).

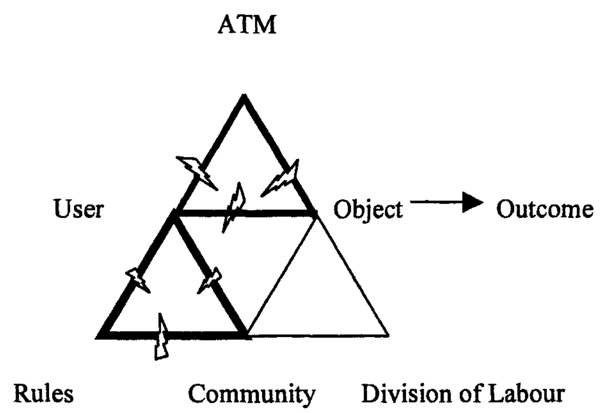

Figure 8.12: Activity System 12 of ATM use showing problems between user, rules community, object and tools elements

In activity 12 the user had problems with the ATM as she made a mistake entering her PIN. A problem occurred as there was no paper in the machine so the user could not get a receipt thus hindering the user's outcome. Contradictions also occurred between the user and the community as she felt the ATM she used was located too near to the entrance to a supermarket. Therefore the user was exposed to shoppers going in and out of the supermarket. The immediate location was very crowded; the user lacked privacy and sensed she had to hurry due to the presence of other people waiting to use the ATM. Other people in the area did not appear to follow the social norms of accepted behaviour and therefore affected this users activity. This user also stated concerns over using an ATM when there was no one around.

'I hung around, you seem to be hanging around for ages and it obviously had ran out of paper and I didn't get a receipt. It was busy I had to wait to use it. I got in line there was one person using it and another person waiting and then I was aware of others. I don't know whether they were waiting of just hanging around about or joining the queue. It's (the ATM) very near to the entrance to the door so there seemed to be people milling around and loads of kids hanging around as well. When I was waiting to use it I felt exposed. I much prefer to go when it's a quieter time, but I still like to have people there. I don't like to be on my own. I don't like going when I'm the only person and there's no one else around. I think oh god is someone going to jump out and suddenly be there. You can always tell if someone is in a hurry behind you to get their money out. I think it is that sound carries and you're aware what the intentions are of other people'.

8.5.10 Temporal effects

Problems also emerged in numerous systems due to temporal effects such as time of day. Users stated at certain times ATMs and the locations they are in are busier than other times thus increasing problems such as lack of space, privacy, safety and an increase in a perceived time pressure from other people in the area. Concerns also emerged over using ATMs when it was dark and the type of people around at the time of use.

8.6 Summary and discussion

The findings from this study highlight several contradictions that exist between the elements within various types of activity systems related to ATM use. Major problems in some of the systems emerged due to the user, community, rules and tool elements. The community and rules elements appeared to have a major effect upon the user compared to the object and tools elements. The findings do show how every interaction is different due to varying context and that interaction is a two way process. Users need to act and react to their immediate environment when undertaking an activity.

Contradictions between the subject (user) and the community show how other people in the immediate environment can influence an individuals use of a technology by not following certain rules of social behaviour e.g. not giving someone enough personal space while they use an ATM. Also, contradictions in certain systems illustrate how other people waiting to use the ATM can influence the user. The user tends to feel a perceived time pressure exists as they do not want to keep others waiting so they will only undertake one transaction when they may have wanted to do two or more. Some systems also highlighted that perceived pressure from others can cause the user to make mistakes e.g. entering wrong PIN. This effect may well be associated to the individual users fears, personality or levels of anxiety. However findings do suggest that social pressure can be a strong invisible force. The actual tool element, in this case the ATM, can also affect the users outcome. For example the machine may not have enough paper in so the user cannot get a receipt or maybe located in an adverse environment. Users stated when the immediate environment is crowded they lack privacy, personal space and do not feel safe. These types of problems increase when the area is busy therefore design and placement of ATMs needs careful consideration so negative influences on the user can be reduced.

8.7 Summary and conclusions

The findings from the first study reported in this chapter are important and help to further understand the factors that influence the use of a technology in a public area.

The use of a technology in a public place, in particular an ATM is influenced by both internal and external factors. The use of AT and the framework proposed by Engeström has given a comprehensive account of how socio-environmental factors impact on use of an ATM. A major strength of applying AT to technology used in public areas is that it emphasises the importance of both internal/external factors and contextual constraints.

8.8 Expanding the AT approach

The previous study demonstrated that human interaction with systems in public places is a complex process. The in-depth interviews revealed various problems and social pressures users experience when using technology in the public domain. The findings highlight how in different contexts similar or diverse problems arise for users of ATMs.

It is not in the scope of this thesis to explore all the principles related to AT but to provide evidence that AT can be applied to existing technologies. Adoption and use of technologies is a complex and continuous process. The previous study has highlighted the importance of context and how this needs to be considered in processes such as design and placement of public space technologies. However qualitative research often lacks verification. Therefore the challenge of the next study was to find if AT could be applied as a verification tool for qualitative work such as that carried out in the first study reported in this chapter. Also to explore if experienced ATM users can generate ideas to eliminate or reduce problems associated with ATM use.

This study reports an innovative idea in which videotaped activity scenarios (VASc) were developed from interviews from the previous study, re-enacted by actors and then used to prompt focussed group discussion.

8.8.1 Scenario use in HCI

Scenarios have been used in HCI research since the 1980's. Burt & van der Heijden (2003) state scenarios help us perceive reality as they use actual contextual information. Different methods can be used such as storyboards, video and other media to develop and discuss scenarios. This in turn through focussed discussion or workshops provide rich descriptions of activities a user might employ while undertaking a particular task in context (Hertzum 2003). For users of technological systems, particularly ones used in public places, different contexts generate different constraints. Artefacts or systems work well if they allow the user to focus on their goal, badly if they do not (Bødker 1996).

Videotaped scenarios have been used by several researchers in the HCI community (e.g. Bødker 1996; Mackay et al 2000). Generally users are videotaped using a device or system and designers or researchers watch the video and discuss any problems, issues or implications for future design (e.g. Bødker 1996). When analysing videotape using an AT approach breakdowns or focus shifts are highlighted within the activity system and consideration is given to aspects of the activity such as what the user is doing and why (Bødker 1996). Breakdowns arise if artefacts or systems behave in a different way other than expected e.g. a computer crashes. Focus shifts are shifts in attention on to something else e.g. a friend walks through the door while you are using a computer. Mackay et al (2000) videotaped expert users at work and used the videotapes in focussed discussion with designers and users providing evidence that video recordings of users can affect the re-design process of a graphical editor. According to Mackay et al videos are powerful tools that can be used throughout the design process from initial observation of users to system evaluation.

8.8.2 Ethical constraints and bias

Although video recording the interaction between user and system in the workplace may be acceptable there exist several ethical concerns over video use in other areas (see Mackay 1995). Ethical issues in research need careful consideration in particular when dealing with systems used in public areas such as ATMs that is generally a very private and personal activity. Sending and receiving personal information in public places may be commonplace in the future. Therefore finding what influences current use is crucial.

Trying to capture a detailed and unbiased interaction between individuals and different technologies used in public places is difficult. Ethically we cannot videotape the interaction without the individual's knowledge nor make assumptions regarding any details pertaining to it. Asking someone to be videotaped may cause embarrassment or bias in how they react. To fully understand any interaction a detailed account is needed that includes a rich contextual description.

8.8.3 Aims

The next study reported in this chapter had several aims:

- To develop AT methodologies by asking focus groups to view videotaped activity scenarios (VASc), developed from previous AT based interviews with ATM users
- To try to further understand the factors that influence the use of technology in public areas, in this case the ATM
- To find if VASc can be used as a verification tool for previous qualitative data
- To explore the idea of rule generation by focussed discussion by actual users can help designers and service providers improve the quality of public space technologies

8.9 Method

Three interviews from the previous study reported in this chapter were developed into videotaped activity scenarios (VASc). The interviews were chosen as they highlighted common themes or problems for users of ATMs. The interviews also revealed how different contexts result in different constraints on users.

8.9.1 Developing videotaped scenarios

The three-videotaped scenarios were produced from the previous interviews. Actors were then used to act out three different types of activity systems identified in the previous research. The actual durations of the videotaped scenarios were around one to two minutes.

Video 1 was developed from an interview with an 18-year-old woman who used an ATM outside a supermarket. This user discussed problems related to the location of the ATM, other people's behaviour in the immediate environment, crowding and not being able to undertake all transactions that the user wanted to do due to a perceived time pressure. When analysed using Engeström's framework of human activity this interview generated activity system 11 (see section 8.6.1.7). For example, problems arose between the user-community-rule elements due to other people coming too close thus reducing her level of privacy and personal space. Problems between the user-community–tool elements arose due her perception that she had to hurry so she did not keep others waiting thus evoking a self imposed time pressure and therefore only undertaking one transaction when she wanted to do two.

Video 2 was developed from an interview with a 38-year-old woman who used an ATM inside a shopping complex. This user discussed problems related to people hanging around the area and a seemingly impatient man waiting to use the ATM. The user was also concerned at the fact there were two adjacent ATMs in this shopping complex and a man specifically waited behind her. When analysed using Engeström's framework of human activity this interview generated activity system 12 (see section 8.6.1.8). For example, problems arose between the user-community-rule elements due to the man acting impatient behind her this made her nervous and concerned over her safety. Problems between the user –tool-object elements arose as she stated that as she felt anxious she began to make mistakes using the ATM.

Video 3 was developed from an interview with a 49 year old man who used an ATM in his local store. This user discussed problems related to the location of the ATM and how it lacked space; he also discussed concern over having to move when in the middle of a transaction to let someone by. When analysed using Engeström's framework of human activity this interview generated activity system 6 (sees section 8.6.1.2). For example, problems arose between the user-community-tool due to the ATM being located in an area that lacked space.

8.9.2 Participants

Thirty-three participants took part in this study, 18 female and 15 males using opportunity sampling. The age range was from 17 to 82 years (mean 34.8 years). Participants were allocated to one of six groups dependent upon age and sex. This resulted in six groups, 3 male and 3 female with ages ranging from 16 to 25, 30 to 60 and 65+ respectively. A decision was made to allocate groups by age and gender as this was seen as the best way possible for participants to feel at ease and hopefully increase discussions. The groups ranged in size, the smallest consisted of three participants and the largest group ten participants. Participants under 60 years of age were recruited from the general population in the Newcastle upon Tyne area of England. Participants aged over 65 years were recruited through the North East Age Research database held at Northumbria University, Newcastle.

8.9.3 Procedure

On recruitment all participants received an information sheet that explained the study. The participants were told that they would be asked to contribute to informal discussions on ATM use and watch short videos of ATM users. They were told that all of the other participants in their particular group would be of approximately the same age and gender and informed that the discussion groups would be videotaped for further analysis. An informal interview guide was used to help the moderator if the discussion deviated from the proposed topic.

Each group began with a general discussion of their personal experience of ATMs, highlighting any issues or problems they experienced. After the initial discussion the first videotaped scenario was shown. Immediately after this each group was asked if they thought there were any issues or problems for the user or other people around the area in the depicted scene. The same procedure was used for the other two-videotaped scenarios. Once all the videos had been viewed and discussed each group was asked to develop a set of rules that could be related to the use and design of ATMs. Groups were asked to pretend they were top designers and needed to develop a set of rules to reduce or eliminate the problems they had highlighted within their discussions. They were asked to consider the environment; the user, the ATM, the task and other people whom maybe around at the time.

This led to six activity systems associated with each group's discussion of use in general, six activity systems related to each of the three different videotaped scenarios and six activity systems related to the rules that each group developed. Overall the groups produced 30 different activity systems. The duration of the discussion groups lasted approximately 90 minutes.

8.10 Analysis

The videotapes of the six discussion groups were transcribed and read. A thematic analysis was employed for the six topical areas: the three videotaped scenarios, ATM use in general, the rules that were generated and the debate on context, culture and temporal effects. The themes or contradictions that emerged from each group's discussion related to the six areas were compared and analysed using Engeström's framework of human activity (whether contradictions or problems occurred as either breakdowns or focus shifts were also noted).

8.10.1 Analysis of Video 1 and 2

All groups discussed and verified the same problems found in the original interviews depicted in VASc 1 and 2. The original problems were identified in activity systems 11 and 12 in the previous study reported in this chapter (sections: 8.6.1.7 and 8.6.1.2). For example the discussion related to VASc 1 highlighted problems between the user, community and rules elements due to other people waiting to use the ATM encroaching on the users space and acting impatiently. Problems were also highlighted due to people walking in between the user and the person next in-line. All of these tensions were seen as increasing pressure on the user, reducing the users levels of privacy and safety.

'That women looked so anxious didn't she, she was so impatient she was getting closer as if in a hurry and if she were annoyed'.

'Those two people walking by I would have felt uncomfortable (if using the ATM)'.

'It's the rule that you have, you don't get taught it, it's just natural. That each person in the queue keeps their distance'.

'It wasn't very private do you know what I mean?'

Discussions related to VASc 2 again verified problems between the user, community and ATM elements such as why a person waits behind the user when there are two machines. The majority of females in the groups stated they would feel more intimidated if it were a man waiting behind them and interestingly males commented they could understand how a female user would feel this sort of pressure. Several males stated that when a female is using an ATM in front of them they tend to purposely give them more space so they do not appear a threat. Contradictions between the user, community and object led to the fact users would tend to make more mistakes when they felt threatened or under pressure from other people in the immediate area. All groups agreed that other people's behaviour reduced levels of perceived privacy and safety. Problems were highlighted between the user, ATM and object such as the machine breaking down, reflecting on the fact it may have ran out of money and that the button noise of the machine draws attention to the user.

'That would upset me because there's another cash point there'.

'(Refers to the fact a man was acting impatient behind the user) By this time I would have made a lot of mistakes because I think he would want me to hurry up'.

'People waiting around the cash point that would make you feel nervous'.

'You wonder what they're doing there, just standing next to it, it's not really a place you would meet and they're just standing there'.

'And the machines making a noise that draws attention to you'.

8.10.2 Analysis of Video 3

VASc 3 was based on the original activity system 6 (section 8.6.1.2 in this chapter). In the original activity system problems emerged between the user, community and tools elements. All six groups discussed and highlighted problems within the whole system and not just between the user, community and tool elements. The majority of problems were highlighted between the user, ATM and community elements such as the ATM being badly situated, the lack of space and the fact the user had to move in the middle of the transaction to let a person by. A few participants pointed out that they would lose concentration on what they were doing thus creating problems between the user, ATM and object. Problems were envisaged between the user, rules and community as other people around could blatantly see what the user was doing;

therefore this would reduce levels of privacy and safety. Also the fact there was nowhere for other potential users to wait and hence crowding in the shop could easily occur.

'I just wouldn't like the idea of keep having to move in and out and it's like the rules again if there's a queue where do they wait. They're not going to give you that space, it's just the shop it's too cramped and close. I wouldn't like that'.

'They shouldn't be able to put them in a shop unless there was a certain amount of space'.

8.11 General discussion

Participants discussed there past experiences of using ATMs in general. All groups highlighted how problems arise due to other people taking too long use the ATM, users stated they tended to change their body postures to try to hide what they were doing and stated a preference for interior ATMs. They also stated some ATMs were badly situated e.g. on street corners and in places were there wasn't enough space for people to wait or walk by. Also that many ATMs were unusable due to the glare from the sun and therefore users are unable to read the information on the screen. Problems also arise due to the fact some ATMs are too slow, users not knowing how to use them, not being able to draw small amounts of money out e.g. £5, the fact ATMs give no warning about why the users card is sometimes kept by the machine. Also some participants stated they sometimes forgot to take their money and that they wouldn't use them to withdraw a lot of money. Discussion highlighted how other people in the immediate environment often act impatient, look suspicious, hang around the area, or encroach on the user's space, the feeling of a perceived time pressure from others and some participants admitted they themselves put pressure on users when they are in a hurry and want to use the ATM. Users also perceive other people watch them which makes them feel nervous, and reduces levels of privacy and safety. Groups also discussed the fact that they did not like withdrawing money in certain locations e.g. on streets and therefore could not check the amount they withdrew.

'The sun's a problem you have to move to see it. That affects your ability to use the ATM'.

'Yeah, when you're using it (the ATM) like that (in the sun) you're concentrating on the sun and not what's going on around you either. It makes you lose concentration of what's going on around you'.

' You don't like it when some people stand too close. You know there's an unspoken rule about how far to stand near people and you know some people don't know the rule'.

'You know if you ask for a balance then you look at it and they say yeah that's alright I'll get some money out and you put your card back in you get a lot of tutting and staring'.

'I don't deliberately do it, I don't intentionally do it. I'll stand behind and I do give them enough space but I'm standing thinking what the hell are they doing I wish they would hurry up, in my mind. I don't intentionally do it but now I think I do look around and think it. I don't do it intentionally it's just because I feel under pressure'.

' That's why you're irritated when the person in front of you does check their balance and then gets money out, then transfers from here to there, they're not suppose to do that at cash point you're supposed to go tap, tap, tap and then go'.

' No that's it you can't stand and count £500 in the street'.

' You try to block their view and space yourself out'.

'Sometimes you press the wrong buttons and the arrows don't line up with the right things, I get the wrong amount'.

' It's intimidating when someone comes too close and they're right behind you'.

8.11.1 Rules

Groups were asked to draw up a set of rules related to ATM use that could be applied to such areas as the design, users, environment, location, the tasks and other people in the area. All groups considered all of the elements within the activity system related to ATM use (Activity Theory or the actual framework was not described to any of the groups). The following quotes highlight some of the rules generated and Table 8.2 lists the rules developed related to each of the elements in framework proposed by Engeström.

'You could if you had a line on the pavement because people are funny if they know a rule they follow that rule and the people who don't are the ones you need to worry about. So there would be fewer people who would step over that line'.

'They should take everything off and make it a fast service so it's only cash you get out'.

'Or they could have something like telephone boxes, where one person can go in and do what they have to do without people being on top of you or get to the side'.

'The most important thing is to have them in enclosed areas'.

'They should be situated in places where there is adequate space'.

Framework Element	Rule
Rules e.g. others behaviour	• Always give the user enough space/privacy • Stand at least one metre away
ATM	• Placed internally and in an enclosed are i.e. a booth • Safety reminders on screen • Cameras installed on ATM • Install panic button or point of contact e.g. telephone • Screen must be well lit • Decrease button noise • Install hood to protect from sunlight and rain • Install touch screens • Overall make ATM smaller • Use biometric verification • Two placed at each location • Cash only ATMs • Alarm installed • Multi-lingual instructions • Install screen on bottom not keypad
Community e.g. environment	• Cameras installed in immediate environment • Install in well lit locations • Environment must afford enough space for user and people waiting • Draw line to mark personal space zone for other people to queue behind • Consider location carefully prior to installation • Place in areas that are accessible and convenient • Do not place on street corners • Install Drive through ATMs
Object e.g. final outcome	• ATM informs user through intelligent machinery why card has been retained and can sense when user had finished • Beep after user has taken money & receipt
User	• Unlimited time to use machine • Always read instruction if new ATM

Table 8.2: Rules developed by groups related to design and placement of ATMs

8.11.2 Context, Culture and Temporal Effects

Changes in context were discussed among all of the groups and they highlighted how in different situations rules and activity systems change. One example of contextual change was the use of an ATM in a pub where problems such as personal space and privacy were no longer considered to be major concerns for some users. Cultural difference were also discussed and the fact that in countries such as Germany, Italy and Spain personal space was not as big an issue to the people of those nations compared to people from the United Kingdom. Cultural differences were also discussed with regard to British people always appearing rushed compared to some of their European neighbours. Temporal effects were also raised, such as how different locations of ATMs were considered to be less safe when using them late at night and also to the type of people who may actually be in the vicinity at a particular time. Particular times of day were also referred to as being busier and creating more problems than others.

'I think you feel more on edge in a place you're not used to rather than a place that you're used to'.

'But everyone's so patient when you go abroad but here everything is just so fast'.

'But then all those rules are completely abolished because you find normally at a cash point people would give you space but in a pub they're leaning over and laughing at your balance'.

'If it were in the street it would be unusual for someone to stand that close to you but in a pub it's not, you're use to it, you think it's normal'.

I used one in a pub a few weeks ago. I used one and it was totally different system to the one on the street. Normally you would put your card in tap your number in then you don't get your card back until the end, you put your card in, type in your PIN then take your card out. I never bothered reading the instructions or anything because you think they're all the same, it never occurred to me because you think you know how to use them. Well I was on for ages with this thing, you think people are looking thinking god what's she doing. Fortunately there was no one waiting so I glanced up and read the instructions I thought I have to take my card out. It never occurred to me to take my card out'.

'Even when you use the cash point in Germany the Germans are secure anyway but there's not that amount of personal space. It might be a cultural thing I only know about Germany'.

8.11.3 Summary and discussion

The novel approach used in this study has shown that VASc can be scripted from interviews and be used very effectively to promote focussed discussion around the topic of interest at very little cost. The study demonstrates how discussions can be successfully interpreted using a thematic analysis and integrated into Engeström's framework of human activity. The methodological process employed has led to verification of those contextual factors that influence the use of an ATM in a public space.

The method itself was very useful in generating group discussions which were richly detailed and tightly focussed around the key areas of interest. For example, the original activity systems that were developed from interviews with ATM users highlighted several contradictions for the users (such as problems arising between the user, community and rules elements). The VASc evoked similar contradictions, but also helped users to identify several more problems that could actually exist within each of the three systems depicted. Contradictions between the user, rules and community showed how other people in the immediate environment could influence technology use, e.g. by violating social rules such as not giving the user enough personal space. Also contradictions revealed the ways in which social pressures could lead to users making mistakes as they feel intimidated or threatened. Groups commented on how use can be affected by the ATM being located in crowded or otherwise adverse environments thus reducing the users perceived levels of privacy, personal space and safety.

8.11.4 Rule generation

After watching the videos all groups generated a set of rules that they thought were important which related to the design and placement of the ATM and the user and other people in the immediate vicinity. The rule discussion led to the groups trying to improve upon the current problems that exist for ATM users. Many different rules were discussed such as the introduction of 'cash only ATMs' thus helping to alleviate the problems associated with queuing and perceived time pressures. Installation of cameras both on the ATM and in the immediate environment, installing ATMs in a booth and using biometric devices instead of cards, these ideas were seen as increasing safety and acting as a crime deterrent. Rules were also generated for other people in the area or who were waiting to use the ATM to abide by such as drawing lines on pavements to increase personal space and affording the user as much time as they like to decrease time pressure. These ideas show how design and placement of ATMs requires careful consideration so that the problems for users can be reduced if not eliminated.

8.11.5 User experience and emotion

Although feelings and emotions from the original users cannot be portrayed on screen, it was easy for the groups to discuss such issues by reflecting on their own experiences and concerns. Groups discussed each videotaped scenario and related this to the context of use. Within the groups individuals talked about their own use and commented on similar problems that had arisen for them such as other people encroaching on the their space. This led to a still wider discussion about context, culture and temporal effects.

8.11.6 Changing context and culture

Each group commented on the fact that rules change for different locations and cultures. For example, using ATMs in locations that were not the norm resulted in behavioural changes and an increase or decrease in the user's awareness. Discussions about age differences highlighted how the display of personal (e.g. financial) information may be of more concern to older people than younger people. Groups were asked if they perceived any difference in the degree of privacy or personal space needed to access financial information via an ATM as opposed to using a public information system to access health information. All agreed that health information was more personal and that they would definitely not want other people to see but felt it would depend upon the actual query.

8.11.7 Exploring breakdowns in activity systems

The exploration of how and why breakdowns occur within activity systems related to ATM use is associated with such things as the machine not giving users small amounts of money or being located in adverse environments. However it is apparent that major problems arise for users of ATMs due to focus shifts. Users of systems regularly have to shift their attention from their activity or action due to other people's behaviour in the immediate environment. Shift in focus can be due to several reasons, as outlined above, but are generally due to lack of privacy or social pressure. The study highlights how actions or operations proposed by Leontiev (1978) can be hindered or even altered by breakdowns or focus shifts within the activity system.

Focus shifts in the user's attention have surfaced as a major problem that can alter their activity which is generally due to other peoples' behaviour in the immediate environment. For example, actions can be influenced as users may want to carry out several transactions but feel they cannot due to a perceived time pressure that exists from other people waiting to use the ATM. At the operational level problems can occur due to the user's belief that all ATMs are the same and therefore they automatically know how to use them. When faced with an ATM that operates differently, users generally do not read instructions therefore they make mistakes and think there is something wrong with the machine.

8.11.8 Revisiting Engeström's framework

Engeström's activity system model provides a useful framework when investigating human activity in context. The model is easy to use and matching the various problems to elements in the system is straightforward. Interpreting problems through the use of Leontiev's activity process helps to identify why and how problems occur. For example, problems associated between the user, rules and community elements analysed at the action level highlights how a users goal can be affected by other people in the area. Therefore an in depth analysis is required to be able to investigate the actual psychological effects on the user of technological systems.

Engeström (1999) stated mediation is through three key relationships: subject–community by rules, subject-object by tools and community-object by division of labour. In the studies reported in this chapter four relationships are apparent between various individual elements: user – tool, mediated by community; user–object mediated by community; user–community mediated by rules and user–object mediated by tools. However, the findings from this study reveal that any element in the system (except the division of labour) can have a unique effect on any one of the other elements. For example, in the first study one user stated cars pulling up at the ATM caused concern shows a direct link between the user and the community elements. Although Engeström's model shows links between all elements the literature seems unclear in describing that all elements have an influence on each other and several combinations of elements can be applied not just three.

This second study has shown how Engeström's descriptive framework can be used to evaluate VASc which in turn are effective, practical and convenient tools for use with discussion groups. As the findings in this study show, these scenarios can be used to promote discussion with experienced users to generate a rich pool of problems that exist for users in different real world contexts. AT is thus revealed as an effective methodology for the study of existing systems, as well as those in early development.

Although the triangle model is useful several problems do exist when applying it to technology use in public areas. One problem occurs when trying to accentuate contradictions within the system; certain elements may have more contradictions between them than others. Engeström uses lightening bolts to highlight contradictions between elements similar to the ones used in this study. However, there does appear a need to be able to emphasise as well as differentiate clearly between the levels of contradictions within the system. The model does not account for temporal conditions such as 'time of day effects'. These have surfaced as an important influence in this study with regard to ATM use. Participants commented that the time of day e.g. nighttime had a major influence on use.

8.11.9 Increasing understanding and verification of problems

The studies in this chapter have provided evidence that AT and VASc can be used to develop our understanding of problems inherent in the use of public space technologies. The findings highlight when using an ATM individuals are influenced by other people in the immediate vicinity, the ATM and the location of the machine. A major strength of applying AT to technology use in public areas is that it emphasises the importance of internal/external factors and that one cannot be fully understood without considering the other, therefore showing how context plays a very important role in technology use.

The study has also highlighted how VASc can be used successfully as a verification tool for previous qualitative research. This is a very important aspect as qualitative research can suffer from poor interpretation and lack reliability. This method could be successfully applied to a vast area of qualitative research with in any field of enquiry.

8.12 Chapter summary

The findings support previous research reported in chapters 6 and 7 of this thesis in that ATM use in a public area is influenced by socio-environmental variables. Problems associated with use in the current study add further evidence and support in that context has a major influence on technological use therefore needs careful consideration in HCI research. The findings add to previous results discussed in this thesis and result in a more comprehensive, global picture of factors and problems that influence use of an ATM in a public zone.

Chapter 9

Manipulating context and device

Research in this thesis has found empirical evidence that privacy influences the use of technology in public places. The first study reported in this chapter investigates whether slight changes to the design of a system can increase users perceived levels of privacy. Chapter 8 discussed how different contexts are constrained by various problems and social pressures for users of public space technologies i.e. ATMs. The second study in this chapter explores the effects crowding has on users of two different technologies. Physiological measures taken in this study show how dealing with personal information on both static and mobile systems can also result in users becoming more aroused. Implications for both designers and service providers are discussed.

9 Introduction

This thesis has found empirical evidence that privacy influences the use of technology in public places. Therefore the first study reported in this chapter investigates whether slight changes in system design increase users' perceived levels of privacy.

9.1 The interface as the first point of contact

A vast amount of people use interactive systems especially in public areas and the first point of contact is often the interface. Several accessibility guidelines exist for interfaces that are used in public areas such as colour and size. Gill (1997) states the interface of systems used in public areas should be large, high contrast (white or yellow characters on a dark background) and illuminated (internally). Morris et al

(1995) suggest interfaces should be no less than 17" for systems used in public areas. This contrasts to the 12" screen generally used for ATM interfaces. These guidelines are aimed at improving accessibility and have not paid consideration to privacy issues. A larger screen may make it easy for the user to see the on screen information, however it also makes it easy for onlookers.

When considering screen size and the associated task it seems apparent that the larger the interface a person interacts with in a public place the less privacy they will have or perceive themselves to have. Privacy is classified as culturally specific and in western cultures definitions of privacy tend to involve management of personal information. Chan (2000) proposed that 'privacy is a subjective response which varies according to individual preference and various social settings'. Privacy does not always refer to social isolation; however in many social situations control over what others may see is needed. Therefore when dealing with personal information a user needs a certain level of privacy so they can interact with the system without concern for other people seeing information on the screen. However when considering ATM use people do not want total isolation, as this may be considered unsafe.

9.1.1 Privacy revisited

Altman (1975) described privacy as an ideal, desired state or as an achieved end state. This statement reflects the fact levels of privacy change dynamically and are affected by both internal and/or external conditions. To gain the desired level of privacy a person tries to regulate their interaction by altering or maintaining their behaviour dependent upon the situation they find themselves in.

Levels of perceived privacy can be increased or decreased dependent upon the task and the physical environment. Research in previous chapters of this thesis has found empirical evidence that several factors influence the use of an ATM in a public area. Findings show privacy, personal space, ease of use and usefulness all have a direct effect on attitude and/or intention to use an ATM in a public area.

9.1.2 Enhancing privacy

Demirbras & Demirkan (2000) used Pedersen's types of privacy for research into privacy regulations used by people in a design studio taking into account spatial characteristics such as the amount of personal space and the effect these factors have on preference for an environment. The studio was open plan although certain physical features such as columns gave the users the opportunity to be by himself/herself and to create private corners within the studio. Therefore the studio afforded both the possibility of both social interaction and avoiding social interaction. Demirbras & Demirkan suggested the use of partitions does affect levels of satisfaction. This latter statement supports research by Oldham (1988) that when partitions are used effectively this can increase perceived privacy and satisfaction.

9.2 Aims

As privacy is an important human need and affects user intentions to use an ATM, it is important to understand the influence the ATM design has on users' perceptions of privacy. The first study reported in this chapter measured users perceived levels of privacy, clarity of information and attitude towards three different screen sizes (12", 15" & 17"). Side partitions were added to each screen to see if there was any effect on the users perceived levels of privacy. The main predictions in this study are:

- Screen size will effect users perceived levels of privacy
- Side partitions added to screens will increase users perceived levels of privacy

9.3 Design

A 3x2 factorial repeated measures design was used in this study. Factor one screen size included 3 levels: 12" screen, 15" screen and 17" screen. Factor two included two levels whether the different size screens had side wings (partitions) attached or not. The dependent variables were participant's subjective ratings of: perceived levels of privacy, clarity of on screen information and attitude towards screen type. Other variables that were measured related to participant's attitudes towards the ATM they use most frequent and type of information they considered to be important that other people should not see on an ATM screen.

9.3.1 Participants – study 1

An opportunity sample was used in this study, 60 participants were recruited from the Newcastle upon Tyne area of England, 29 males and 31 females. The age range was from 16 to 65 years (mean 28.85 years). Participants took part in all six conditions; random allocation to each of the six conditions was used as a control factor in this study.

9.3.2 Apparatus & Materials

NCR Financial Solutions LTD., Dundee, UK supplied three flat computer screens: 12", 15", and 17". Each of the three screens was independently enclosed in white cardboard surrounds and cardboard wings were added or removed on both sides of each screen dependent upon condition (see Figure 9.1). All screens were set at a standard height distance that measured 900mm from the floor to the bottom of the screen. All three screens were linked to separate computers. For recording purposes each screen type was allocated a number: **1** – *12" screen without wings attached*, **2**- *15" screen without wings attached*, **3**- *17" screen without wings attached*, **4** – *12" screen with wings attached*, **5**- *15" screen with wings attached*, **6**- *17" screen with wings attached.*

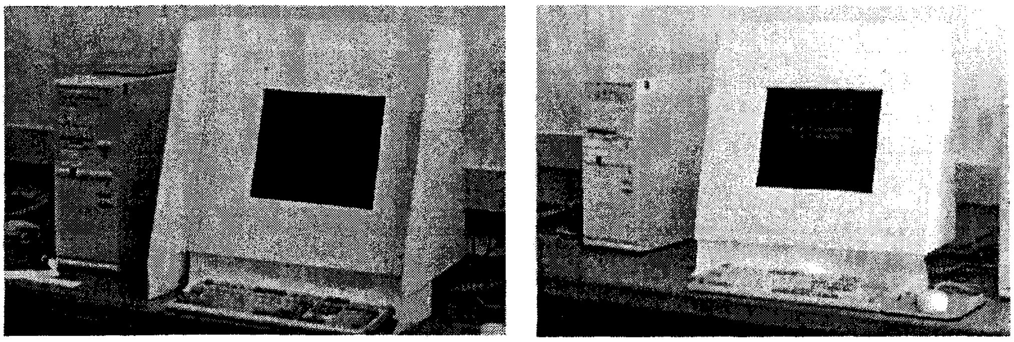

Figure 9.1: Example of screen with and without wings attached

9.3.3 Program development

A program[1] was developed for use in this study consisting of twelve statements. Participants responded to each statement using a bipolar scale of 1 to 7, where one was very likely or I agree with this statement to 7 very unlikely or I do not agree with this statement (the statements are listed in Appendix E). Statements were linked explicitly to previous research where possible e.g. *Other people would be able to see my personal information on this screen* (Pedersen 1999). The program automatically recorded the participant's response to each statement. Five of the statements related to levels of perceived privacy. Five of the statements related to clarity and presentation of on screen information. Two statements related to the participants attitude regarding

[1] The program was developed by R.Steel, a psychology technician at Northumbria Unviersity.

their overall opinion of each screen type. The statements are listed below in their respective category:

Privacy statements:

When I use this screen other people can see what I'm doing.

Other people would be able to see my personal information on this screen.

When using this screen the only time I believe I would have enough privacy is when no one else is around.

I would feel uncomfortable using this screen if there was someone queuing behind me.

My privacy would be at risk using this screen.

Clarity of screen information statements:

This screen is just the right size for dealing with personal information.

This screen size makes use easier.

This screen size enables me to complete my task quickly.

This screen size makes the information clear and precise.

I do not feel comfortable with this screen size.

Attitude statements:

All things considered I do not like this screen.

All things considered, I find this screen pleasant.

9.3.4 Measuring ATM use in general

A short questionnaire was constructed which related to participants perceptions of privacy, personal space, ease of use, usefulness and clarity of screen information for the ATM they use most frequent (the questionnaire can be found in Appendix E). The questionnaire used a semantic differential scale that related to each measured concept e.g. *The level of privacy at the ATM I use most frequently is:*

Good |-------|-----|-------|--------|-------|------|--------| Bad

Four semantic differential scales were used for each category. Participants were instructed to place a cross on the line where they most agreed with the statement. The scales were scored from 1 to 7 with 1 being a negative response to 7 a positive response. The questionnaire also included 10 different types of information that may appear on an ATM screen e.g. your name, account number. Participants were asked to rate the different types of information on a scale of 1 to 7 they would not like other people to see, 1 was rated as very important information they would not like other people to see and 7 rated as information that if other people could see was not important.

9.3.5 Procedure

The experiment was counterbalanced and a random procedure was used all participants took part in all six conditions and were tested individually. Each participant was randomly allocated to one of the conditions at the beginning of each experimental trial. All participants were instructed on how to carry out the task. Before each participant began his or her participant number and screen type were entered onto each of the individual screens. Each participant approached one of the six screens, they then began to answer all of the questions related to privacy, clarity of screen information and attitude towards that particular screen type. When participants finished rating each statement using a scale from 1 to 7 on one screen they moved onto the next screen and so on until they had completed the task on all six-screen types. While participants were completing one trial, privacy wings were either removed or added to one of the other screens dependent upon condition.

After each participant had completed the task on all six screens they were asked to complete the short questionnaire related to their perceived levels of privacy, personal space, ease of use, usefulness and clarity of screen information for the ATM they use most frequent. 59 participants completed the questionnaire, 1 participant stated he did not use ATMs; therefore he only completed the demographic variables and the rating of importance of other people seeing information on a screen. Testing took approximately 10 minutes. Once each participant had completed the screen tasks and questionnaire they were thanked and debriefed.

After all 60 participants had completed all six conditions data was recorded. Means were calculated and totalled for all participants' responses. This resulted in mean scores for levels of perceived privacy, clarity of information scores and attitude towards each screen type. The data from the screens was then analysed using a two way repeated measure ANOVA (the ANOVA can be found in Appendix E).

The questionnaire which measured participants' perceptions of levels of privacy, personal space, ease of use, usefulness and clarity of screen information for the ATM they used most frequent was also scored. Means were calculated for each different category and comparisons made

9.4 Results

All data was screened for normality using SPSS. A 3 x 2 repeated measures ANOVA was applied to the screen data. Descriptive statistics were calculated for the questionnaire.

9.4.1 Screen data -privacy

Comparison of the means for the six screen types revealed the 12" screen with wings attached (mean 3.95) and the 12" screen without wings attached (mean 3.53) were rated higher for levels of perceived privacy compared to all of the other screen types. The 17" screen without wings (mean 1.71), the 17" screen with wings (mean 2.08) and the 15" screen without wings (mean 2.13) were rated the lowest for levels of perceived privacy (see Table 9.1)

N=60	**Mean - privacy**	**Sd.**
12" screen/no wings	3.53	1.53
15" screen/no wings	2.13	1.04
17" screen/no wings	1.71	1.02
12" screen/wings	3.95	1.54
15" screen/wings	2.97	1.87
17" screen/wings	2.08	1.21

Table 9.1: Mean rating for levels of perceived privacy for each screen type.

The ANOVA revealed a significant effect on levels of privacy between the different screens with side wings and screens without wings; $F\ (1,59)= 33.487$, $p< 0.001$. The ANOVA revealed a significant effect on levels of privacy between the different sizes of screen i.e. 12", 15" and 17"; $F\ (1,59)= 99.483$, $p<0.001$. There was no significant interaction effect between screen size and side wings or no side wings; $F\ (1.59)=1.474$, $p=0.230$.

Although the interaction was not significant, there did seem to be differences between mean ratings across different screen sizes and wing/no wing conditions. Thus a set of post hoc analyses were applied to the data to explore this further.

9.4.2 Post-hoc comparisons

Post-hoc comparisons were carried out using the Scheffé method to find where the difference between screens occurred.

Analysis revealed that the 12" screen with wings attached was rated significantly higher for levels of perceived privacy (at the 0.01 level) than the both 15" with/without wings and the 17" with/without wings screen type. The 12" screen with wings was rated significantly higher for levels of perceived privacy (at the 0.05 level) compared to the 12" screen without wings.

The 12" screen without wings was rated significantly higher for levels of perceived privacy (at the 0.01 level) than the 15" without wings and both the 17" with/without wings screen type. The 12" screen without wings was rated significantly higher for levels of perceived privacy (at the 0.05 level) compared to the 15" screen with wings.

The 15" screen with wings was rated significantly higher for levels of perceived privacy (at the 0.01 level) than the 17" without wings screen type. The 15" screen with wings was rated significantly higher for levels of perceived privacy (at the 0.05 level) compared to the 15" screen without wings.

No other significant differences were found between any of the other screen types.

9.4.3 Clarity of Screen Information

Comparison of the means and standard deviations for clarity of information presented on the screens revealed only a slight variation between the different screen types (see table 9.2).

N=60	**Mean - clarity**	**Sd.**
12" screen/no wings	3.51	.93
15" screen/no wings	3.27	.99
17" screen/no wings	3.74	1.32
12" screen/wings	3.90	1.06
15" screen/wings	3.23	.93
17" screen/wings	3.93	1.13

Table 9.2: Mean rating for clarity of screen information for each screen type.

The ANOVA revealed no significant effect on clarity of information that appeared on the screens between the screens with wings and the screens without wings F (1,59)= 0.196, p=0.66. The ANOVA revealed no significant effect on clarity of information that appeared on the screens between the 12", 15" and 17" sizes; F (1,59)= 0.811, p=0.371. There was a significant interaction effect between screen size and whether side wings were added or not; F (1.59)=18.757, p<0.001.

Observations for Table 9.2 and Figure 9.2 show ratings for clarity of information on the three screen sizes and whether wings were added or not. The 15" screen is rated lower for clarity with and without wings attached compared to the 12" and 17" screen with and without wings attached. When wings are attached to the 12" and 17" screens they are rated slightly higher for clarity of on screen information compared when wings are not attached to these screens.

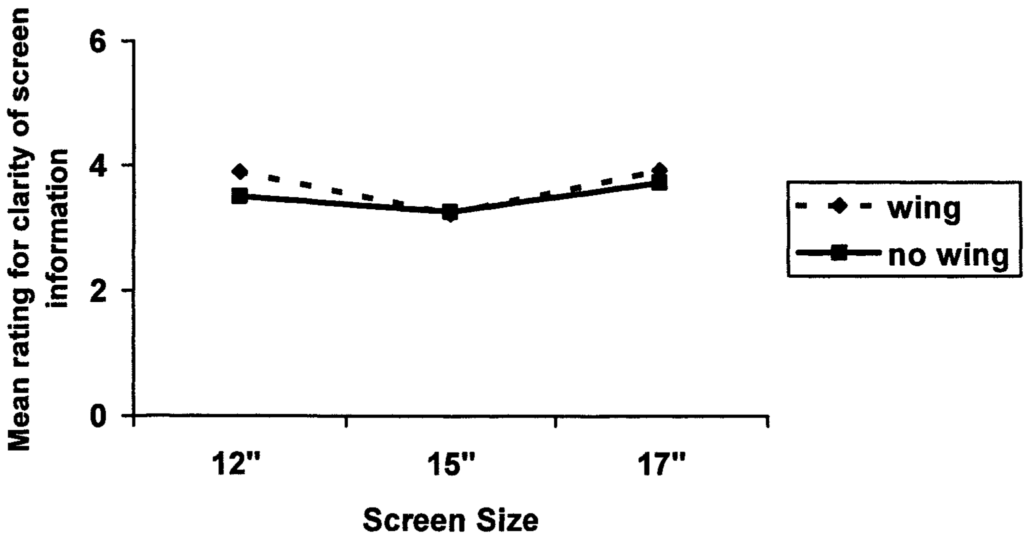

Figure 9.2: Mean rating for clarity of information between the three screen sizes and with/without wings

9.4.4 Attitude Towards Screen Types

Comparison of the means for the six screen types revealed the 12" screen with wings attached (mean 3.96) was rated more positively for attitude towards that particular screen compared to all of the other screen types. The 15" screen without wings (mean 3.57) and the 12" screen without wings (mean 3.67) were rated the lowest for attitude towards the different screen types (see Table 9.3).

N=60	Mean- attitude	Sd.
12" screen/no wings	3.67	.86
15" screen/no wings	3.57	.96
17" screen/no wings	3.70	1.04
12" screen/wings	3.96	.84
15" screen/wings	3.80	.90
17" screen/wings	3.81	1.10

Table 9.3: Mean rating for attitude towards each screen type.

The ANOVA revealed a significant effect of attitude towards the screens with wings and the screens without wings; F (1,59)= 8.467, $p < 0.005$. The ANOVA revealed no significant effect of attitude between the 12", 15" and 17" sizes; F (1,59)= 0.633, p=0.633. There was no significant interaction effect between screen size and whether side wings were added or not; F (1.59)=0.648, p=0.424.

Post-hoc comparisons were carried out using the Scheffé method to find where the difference between screens with and without wings.

Analysis revealed that only the 12" screen with wings was rated more positively (at the 0.05 level) with regard to attitude towards that particular screen compared to all of the other five screen types. No other comparisons were significant ($p > .05$ in all cases).

9.4.5 Questionnaire ratings for ATM use

Overall means for the questionnaire revealed that ATMs are rated positively in this study as easy to use (mean 6.01) and useful (mean 6.13). The levels of perceived privacy (mean 4.42) and personal space (mean 4.52) are rated less positively. The clarity of screen information that appears on an ATM (mean 4.16) is again rated less positively than how easy an ATM is to use and how useful it is (see Table 9.4).

N=59	**Mean**	**Sd.**
Privacy	4.42	1.35
Personal Space	4.52	1.27
Ease of Use	6.01	.90
Usefulness	6.13	.81
Clarity of information	4.16	.92

Table 9.4: Mean ratings of ATMs used most frequently in this study for levels of privacy, personal space, ease of use, usefulness and clarity of screen information.

9.4.6 Privacy of on-screen information

Means were calculated for the importance of the type of information that may appear on a screen. An account number (mean 1.67) was rated as the most important type of information that participants in this study would not like other people to see. A name was considered to be the least important type of information that participants would not like other people to see (see Table 9.5).

Type of Information	Mean	Sd.
Name	3.67	2.14
Address	2.47	1.85
Account No.	1.67	1.37
Account Balance	2.20	1.46
Money Borrowed	2.62	1.67
Mortgage	3.03	1.98
Salary	2.77	2.01
Overdraft	2.60	1.70
Amount you spend	3.32	1.97
What you spend on	3.45	2.17

Table 9.5: Importance of type of information that other people may see on an ATM screen

9.5 Section Summary and discussion

The findings from this study reveal a significant effect of screen size and type on participant's perceived levels of privacy and attitude towards them. Results show the 12" screen with wings attached was rated significantly higher for perceived levels of privacy compared to all of the other screen sizes and types. The 12" screen without wings was rated significantly higher for perceived levels of privacy compared to all of the other screen sizes and types except the 12" screen with wings attached. The 15" screen with wings attached was rated significantly higher for perceived levels of privacy compared to the 15" screen without wings and the 17" screen with or without wings. Results revealed participants' attitudes towards the different screen sizes and types was significantly more positive towards the 12" screen with wings compared to the other five screen types.

9.5.1 Designing for accessibility or privacy?

While researchers such as Morris et al (1995) state screen size of interfaces used on technology in public places should be no less that 17", they are basing this guideline on accessibility. These larger screens have a negative impact on perceptions of privacy and may not be appropriate for private transactions in a public environment. The findings from this study reveal that when dealing with personal information 12" screens with added side wings are the most suitable type of interface for users of technology in public areas. Maguire (1999) states systems that are used to access personal information should be designed to allow the user's body to conceal their interaction from others. The findings in this study support this concept, as larger screens do not allow users to fully conceal the information that appears on-screen from other people who may be around in that particular area.

In this study guidelines for the appearance of information on-screen were followed. A dark blue background was used with high contrast yellow characters (font size 18, Times New Roman); this is in accordance with suggestions by Gill (1997). No differences were found between any of the screen sizes and types for clarity of on-screen information. This suggests that smaller screens such as 12" can appear just as clear as 17" screen's providing too much information is not presented at once.

9.5.2 Privacy perceptions

This study shows how external factors e.g. screen size and type can dynamically change an individual's level of perceived privacy. This supports two of the dimensions proposed by Burgoon (1982) physical (screen size or type) and psychological (user perceptions). The privacy statements that appeared on-screen were developed from previous research by Pedersen (1999). The findings support that dimensions of privacy proposed by Pedersen such as reserve (not revealing personal information about oneself to others), isolation (being geographically removed from and free from others observation) and solitude (freedom from observation by others) are important factors that can affect use of a system.

The findings support previous research by Demirbras & Demirkan (2000) and Oldham (1988) in that adding partitions in strategic places can increase individuals' levels of perceived privacy and satisfaction. The findings from this study show that by adding side wings or partitions to a screen this can increase participants perceived levels of privacy and result in a more positive attitude towards that particular screen type.

Interestingly when participants were debriefed and given a full explanation of the experiment the majority commented they had not noticed that wings had been either added or removed to any of the screens. This perhaps reveals how privacy can be subtly enhanced by changes to the design of systems used in public areas. There appears a need to consider the actual task the system is used for and this should be reflected in the design. When dealing with personal information a user needs a certain level of privacy so they can interact with the system without concern for other people in the immediate environment. Therefore systems used in public areas need to be designed so that regulating and maintaining a desired level of privacy does not cause concern for the user. When dealing with personal information on public systems e.g. entering PIN, invasion or violation of privacy can occur. If invasion or violation occurs privacy is lost and dependent upon the importance of the information e.g. someone seeing his or her PIN or account balance, this will result in a negative effect on the user.

9.5.3 Section summary

As stated earlier a core theme in HCI is to objectively design, construct and evaluate computer-based interactive systems so people can use them efficiently, effectively, safely and with satisfaction (Hartson 1998). When considering systems used in public areas in particular ones that are used to access personal information size and type of interface need careful consideration. Privacy is an important factor that needs to be considered in the design process.

9.6 Effect of density and device –study 2

In chapter 8 context emerged as a key variable that influences the use of technology in public areas. Discussion highlighted how different contexts are constrained by various problems and social pressures. This thesis has uncovered major problems for users of ATMs are associated with other people's behaviour in the immediate environment. Perceptions of privacy, personal space and safety are all reduced when other people are in the immediate environment. The challenges in the second study reported in this chapter are to find if dealing with personal information in a crowd is more stressful compared to when alone and to find if this is dependent upon device type i.e. either a static or mobile system.

9.6.1 Crowding and stress

For more than two decades many studies have reported a link between acute and chronic exposure to environmental stressors e.g. noise, crowding, traffic congestion, pollution and human motivational deficits (Evans & Stecker 2004). The effects of crowding and personal space invasion were discussed in depth in chapter three. Actual stress due to crowding to a large extent, is a consequence of having to interact with too many people at any one point in time, excessive stimulation or social overload syndrome (Saegert 1978), reduced behavioural freedom (Sundstrom 1978) or unwanted uncontrolled interaction (Baum & Valins 1977). Perceived control is a strong mediator of crowding stress and less control is generally associated with high density (Strube & Werner 1984). For example, Sinha & Sinha (2001) found in high-density conditions and when personal space was violated participant's performance on simple tasks was not affected compared to performance on complex tasks in the same conditions.

The effects of psychological stressors are mainly associated with physical ones (Zayan 1991). Freeman (1987) describes crowding as a physical stressor. Zayan (1991) argues strangers can also act as a specific type of physical stressor. However previous crowding research does not measure this phenomenon independently.

9.6.2 Heart rate variability and type of task

Heart rate variability is one way to assess change in individual's levels of arousal. As heart rate is neurally mediated monitoring change can indicate the status of the central nervous system (Porges & Byrne 1992). Selye (1936) recognised that when faced with a stressor the human body reacts by making physiological changes. One of the physiological changes the human body makes towards a stressor is increased heart rate.

Previous research tends to evaluate stressful events by presentation of complex and simple tasks. When individuals are faced with cognitive tasks they cope actively (e.g. mental arithmetic). In comparison when confronted with environmental stressors (e.g. personal space invasion), although stressful, individuals cope passively. Physiological findings show coping actively raises blood pressure via changes in heart rate compared to passive coping. Although passive coping elevates blood pressure there tends to be no significant change in heart rate (Williams 1986, Sawada 1993).

Heart rate variability has also been used to measure intrusion into personal space (Yaezawa & Yoshida 1981, Sawada 2003). Yaezawa & Yoshida (1981) reported participants heart rate increased by seven beats per minute when approached by an experimenter. They also recorded participants' subjective feelings of anxiety and tension and found these increased substantially throughout the whole approach.

Wilson & Sasse (2001) measured heart rate variability in media quality degradation tasks. They found poor quality media has a physiological impact on users of such systems and this is reflected in increased heart rate. Interestingly they also found no correlation between participant's subjective ratings of the task compared to the change in their physiological state. Wilson & Sasse argue physiological responses are more reliable measures compared to subjective methods that are cognitively mediated. They further suggest in the case of media degradation a physiological response occurs without users being aware of any such affect.

9.6.3 Manipulating device

Research in this thesis has tended to focus on ATM use. As handheld devices are now commonplace context of use therefore becomes more dynamic. Users of mobile devices are free to move around or even hide the device from others. The interface on mobiles is very small affording the user more privacy in comparison to ATM screens. Therefore dealing with personal information on a handheld device even when in a crowd in contrast to using an ATM may result in a less stressful interaction. This latter statement outlines the second challenge of this study.

9.6.4 Types of information

The type of task devices are used for may have a major impact on use. Systems are now used to access a host of information ranging from bus timetables to health advice. The study reported in chapter eight highlighted how participants viewed health information as more personal than financial. This is interesting as the government in the UK have now began to install health information kiosks in a variety of different places e.g. GP surgeries, libraries. If users perceive health information as more personal will this affect use? Imagine you want to find more information related to a sexually transmitted disease. You walk up to the nearest health kiosk and tap in your enquiry, a few people begin to queue behind – would you feel comfortable? Furthermore the radio frequency tag built into your jacket communicates with the kiosk and information is passed between the two devices. Somewhere someone knows not only what your query was but also who you are! Although somewhat futuristic it may be possible.

Hine & Eve (1998) stated to participate in today's world people must reveal some personal information at some point e.g. the data trail left after credit card use. They investigated what type of data and technology, if any, was viewed as more personal. Findings revealed no one type of data was viewed as personal. Hine & Eve proposed five factors related to how intrusive the data or technology was the more visible the technology the less users perceived it as intrusive, the legitimacy request and motive for information, intrusion or disruption of the legitimate activity, the imbalance of power and control, finally social context of information exchange. They concluded infringement of privacy is complex and there is no common set of privacy sensitive issues that can simply be applied to technological innovations in order to predict their likely effects on privacy. Although Hine & Eve discuss privacy as a core theme, their research appears to focus on information exchange and trust in technology. In the interviews they carried out participants hardly mentioned or discussed how personal the actual data or information they exchanged was. Therefore the third major challenge in this study is to find if different types of information are considered more personal than other types.

9.7 Aims

The aims of the present study are to further quantify findings from previous research carried out in this thesis. Findings have highlighted how use of both static (e.g. ATMs) and mobile (e.g. mobile telephones) devices are affected by levels of perceived privacy and personal space. Perceived levels of privacy and space are often reduced due to other people's presence or behaviour in the immediate environment. Further investigation is needed to find if using a static device is more stressful compared to using a mobile device. Therefore exploration is made to see if dealing with personal information on a 12" screen (described earlier in this chapter) is more stressful in contrast to dealing with personal information on a handheld device. Exploration is also made to see if dealing with information when alone is less stressful compared to dealing with information in a crowd. Differences will also be examined between different types of information to find if any is considered more personal compared to others. The main predictions in this study are:

- Dealing with personal information will be more stressful in a crowd compared to dealing with information when alone
- The use of a static system will result in a more aroused state when dealing with personal compared to using a mobile device
- Increased levels of arousal will be associated with different types of information e.g. health compared to information that is classed as personal

9.8 Design

A 2x2 factorial independent measures design was used in this study. Factor one type of device included 2 levels and related to receiving personal information on either an iPAC or PC. Factor two included 2 levels related to either receiving personal information when alone or in a crowd. The dependent variables were participants' subjective ratings of how personal each statement was that appeared on screen and their reaction time to the statements. Participants' heart rate was also recorded to find if any change occurred when receiving personal information in crowded conditions compared to when alone. Heart rate was also used to determine if any changes occurred between the different device types i.e. PC or iPAC. Other variables measured related to participant's attitudes towards the privacy, clarity of on-screen information and attitude towards the type of device used.

9.8.1 Questionnaire

Twenty statements related to personal information were developed (the questionnaire can be found in Appendix F). These statements related to four main types of information: personal, financial, health and self- knowledge. The statements were randomised on the final questionnaire to reduce response bias. The statements are listed below in their respective category:

Personal:

1. What is your home telephone number?

2. What is your mobile telephone number?

3. What is your home address?

Financial:

4. What is your main bank account number?

5. What is your current bank balance?

6. How much are you in debt?

7. What is the gross income of your family?

8. What is your salary?

9. How much are you overdrawn in your current account?

10. What do you spend the most money on each month?

Health:

11.How many sexual partners have you had?

12.What is your true weight?

13.Have you ever been tested for a sexually transmitted disease?

14.How many times have you taken illegal drugs?

Self-knowledge:

15.Name a person from university or work who you dislike.

16.Name a person from university or work who you find sexually attractive.

17. In the past year what is the biggest lie you have told

18. State an item or something you have stolen

19.State something about yourself you would not like others to know.

20.State your most embarrassing moment.

9.8.2 How personal is personal?

To find how personal people considered the statements a short survey was conducted on an opportunity sample of twenty males and twenty females. The participants were recruited from the Newcastle upon Tyne area. The age range was from 16 to 62 years (mean 36.07 years). Participants rated each statement on a scale from 1 (not at all personal) to 5 (very personal). Means were calculated for each of the four categories and comparisons made. Participants rated health information as more personal/private and personal information as the least. Table 9.6 shows the overall mean responses and standard deviations for the four types of information (the rating questionnaire can be found in Appendix F).

	Mean rating	Sd.	N
Personal	2.47	1.28	40
Financial	3.49	.95	40
Health	3.73	.96	40
Self	3.05	.51	40

Table 9.6: Mean rating for how personal participants rated each category of statements on the questionnaire

9.8.3 Participants – study 2

An opportunity sample was used in this study, 68 participants were recruited from Northumbria University and the Newcastle upon Tyne area of England, 28 males and 40 females. The age range was from 18 to 52 years (mean 25.26 years). Participants were not screened for health, legal or illegal substances.

9.8.4 Apparatus

The 12" screen with added side wings described in the previous study reported in this chapter was used in both the alone and crowded 'PC' conditions. The screen was attached to a standard pc. A handheld iPAC pocket pc manufactured by Compaq was used in both alone and crowded 'iPAC' conditions.

9.8.4.1 Physiological measurement

Participants' heart rate was recorded via a Biopac system linked to a laptop computer. A pulse monitor recorded heart rate via an electrode attached to their index finger. Participants were asked if they were right or left handed at the beginning of each trial and the probe was attached to the opposite hand. A three-minute baseline measure was taken for each participant before they began each trial.

9.8.4.2 Additional materials

A program[2] was used to generate a list of 100 random 4-digit ID numbers. Along with the actual questionnaire briefing, consent forms and debriefing sheets were developed explaining the nature of the research procedure and aims (these can be found in Appendix F). A questionnaire based on the privacy, clarity of screen information and attitude statements from the previous study reported in this chapter was also used (this can be found in Appendix F). Participants rated these statements on a scale from 1 (very likely or I agree with this statement) to 7 (very unlikely or I disagree with this statement).

9.8.4.3 Program development

All twenty statements were incorporated into a program for use in the actual experiment. The program automatically generated six random statements from the original questionnaire in each trial. Participants responded to each statement using a bipolar scale of 1 to 5, where one related to 'I do not find the information in this statement private/personal' to 5 'I find the information in this statement very private/personal'. The program recorded participants' rating and response time for each statement. The procedure when using each device was participants were presented with a statement, they responded using the bipolar scale then an answer appeared on screen. The program was timed so that after participants responded to the statement the answer immediately appeared on screen. Every answer remained on-screen for 7 seconds in which time participants could not remove the answer or respond further. The answers that appeared on screen were developed explicitly for the program and not intended in any way to be linked to any individual participants

[2] The program was developed by Dr. D. Wakelin, a senior lecturer in the Division of Psychology at Northumbria University

actual response on the questionnaire e.g. Statement: The person you find attractive sexually attractive is, Answer: Homer Simpson. After each participant had been presented with six statements and answers the program thanked them for their participation.

9.8.5 Procedure

Potential participants were presented with a briefing that described the nature of the study. An important part of this study was for participants to believe they would receive personal information on different devices therefore deception was needed. Participants were not informed of the true aims until they were debriefed at the end. Initially, participants were asked to read and sign the consent form attached to the questionnaire if they wanted to participate and informed they would be paid £5 for their time. If participants agreed to take part they were asked to choose a four-digit identification number (ID) from the list provided and cross the number off to ensure no two people had the same ID number. They were all informed it was very important they remembered this number and did not reveal it to anyone. No names or any identifiable information was otherwise recorded. Participants were led to believe they would need this ID number to access the program used in the study and the relevant information associated with their number.

Participants were then asked to complete the questionnaire as truthfully as possible and place the completed form in the envelope provided. The sealed envelope was placed in a sealed box in the Division of Psychology office at Northumbria University. Participants were deceived into thinking the sealed envelope was passed to a third person who entered the information they provided into a computer program.

In fact once participants placed the sealed envelope into the box, the envelopes were removed unopened and shredded immediately. Once the questionnaire was completed participants chose a time and date to attend the lab to take part in the main study.

On arrival at the lab participants were allocated to one of the four conditions: crowded PC, crowded iPAC, alone PC, alone iPAC. In the alone condition the lab environment was kept free from any interruptions, the experimenter either stood outside the lab or stayed in the opposite corner and faced a computer. Participants received the following verbal briefing:

'Before you begin you need to enter your personal ID number into the device. You will be presented with six statements generated randomly from the original questionnaire. As the program generates statements randomly certain statements may not apply. If you have been allocated to one of the crowded conditions and a statement appears on screen that you did not answer on the original questionnaire please do not let anyone else in the lab know This is so the three other participants present will not know what statements are true and which are false. If you are allocated to one of the crowded conditions the other participants will be trying to access the on screen information. These participants will be offered an incentive to try to see as much information as possible. Participants who are trying to see the on screen information will be placed in various positions around the room and must not intentionally invade your personal space. Therefore when confronted with the information you must try to keep the information as private as possible but you must not cover the screen with your hands or use any similar behaviour. When a statement appears you need to rate this statement using the scale on the bottom of the screen for

how private you believe it to be. The scale ranges from 1 not personal to 5 very personal. Once you have rated the statement an answer will appear on screen, the answer may be the one you gave on the questionnaire or the answer may be a randomly generated one by the program. Again if the answer is not the one you gave on the original questionnaire please do not let any one know. When you have been presented with six statements a thank you note will appear on screen. . Throughout the procedure your heart rate will be monitored using an electrode attached to your index finger. After this the pulse monitor will be removed. You will then be presented with a short paper questionnaire related to your opinion about receiving information on the device you used'.

In the crowded conditions participants using either the PC or iPAC were led to believe the three other participants would be trying to see as much information as possible. In fact the 'other participants' were confederates who were fully aware of the true aims. The confederates did not try to access any details related to the on screen information but noted how much, if any, information they could see, if the participant appeared anxious, if he or she made any postural changes and if so what the changes were (see Appendix F for confederate rating sheet). The confederates rated how anxious the participant appeared on a scale of 1 (very anxious) to 7 (not at all anxious). Confederates were placed at three strategic points around the room approximately 1 metre away from the participant. A schematic representation of the layout is shown in Figure 9.3.

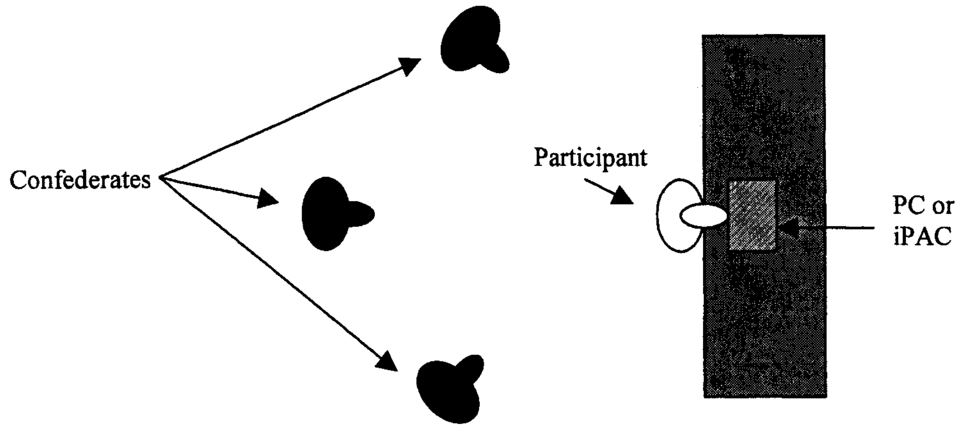

Figure 9.3: Schematic layout of position of participant and confederates in the crowded conditions

After the main experimental trial and before each participant was debriefed they completed a paper questionnaire based on the privacy, clarity of screen information and attitude statements from the previous study reported in this chapter.

After all 68 participants had completed all the tasks and were fully debriefed data was recorded. Means were calculated and totalled for all participants' responses. This resulted in mean scores for the baseline heart rate data prior to the task, heart rate data during the task, reaction times, ratings of on screen statements, levels of perceived privacy, clarity of information scores and attitude towards each screen type. Heart rate was compared using mean beats per minute (BPM).

9.9 Results

All data was screened for normality using SPSS. Two participants heart rate data in the iPAC alone and the PC crowded conditions was not recorded correctly. Therefore this data was dropped for all the heart rate analyses. A decision was made to keep the number of participants equal for this analysis this resulted in one participant's data from the iPAC crowded and PC alone dropped from further heart rate analysis, these were chosen randomly. As participants were presented with six random statements during the experiment this resulted in unequal sample sizes for the four conditions and categories.

Where appropriate two-way ANOVA's were applied to the data to find any differences between all four conditions (alone, crowded, iPAC, PC), reaction times and on screen ratings (the ANOVA outputs can be found in Appendix F)..

9.9.1 Heart rate between the four conditions

The mean baseline heart rates related to the four conditions resulted in the following alone (64.21 BPM), crowded (69.82 BPM), PC (67.98 BPM) and iPAC (66.04 BPM). The mean heart rates related to receiving personal information in the different conditions were alone (90.33 BPM), crowded (99.04 BPM), PC (100.73 BPM) and iPAC (88.65 BPM). A graphical depiction of the mean baseline heart rates and mean heart rates for the alone, crowded, PC an iPAC conditions are shown in Figure 9.4.

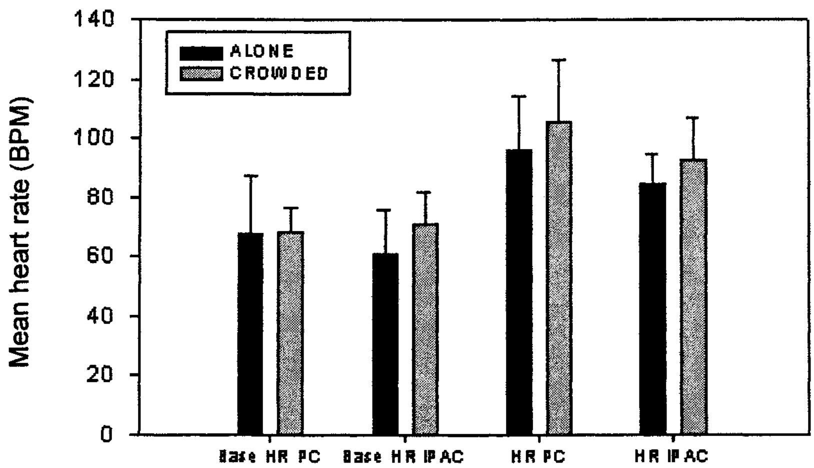

Figure 9.4: Mean baseline heart rate and mean heart rate in the alone and crowded conditions using either a PC or iPAC device

The ANOVA revealed no significant effect of baseline heart rate between the iPAC and the PC conditions prior to starting the task F (1,63) = .304, p=0.583. The ANOVA revealed no significant effect of baseline heart rate between alone and crowded conditions prior to starting the task F (1,63) = .2.557, p=0.115. The was no significant interaction effect of device and alone or crowded conditions F (1,60) =2.082, p=0.154.

The ANOVA revealed a significant effect of heart rate between the iPAC and the PC conditions during the task F (1,63) = 8.477, p <0.05. The rise in heart rate was significantly higher when dealing with information in the PC condition compared to the iPAC condition.

The ANOVA revealed a significant effect of heart rate between alone and crowded conditions during the task F (1,63) = 4.410, p <0.05. The rise in heart rate was significantly higher when dealing with information in the crowded condition compared to the alone condition.

There was no interaction effect of heart rate between the two devices and alone/crowded conditions during the task F = (1,60) .851, p =0.851.

9.9.2 Rating of on-screen questions

The mean rating for all questions between the four conditions resulted in the following alone (3.10), iPAC crowded (3.09), PC (2.98) and iPAC (3.21). The higher the mean score the more private the information was rated.

The ANOVA revealed no significant effect of rating questions more personal/private in the alone or crowded conditions F (1,67) = .003, p=0.959. The ANOVA revealed no significant effect of rating questions more personal/private in the iPAC or PC conditions F (1,67) = 3.201, p=0.078. There was no significant interaction between rating questions on either device and the alone/crowded conditions F (1,64)= 3.228, p=0.077.

9.9.3 Reaction time to on-screen questions

The mean reaction time for all questions between the four conditions resulted in the following alone (5.56 secs.), crowded (5.30 secs.), PC (4.97 secs.) and iPAC (6.23 secs). Table 9.7 shows the means and standard deviations in the alone and crowded conditions for the two devices.

	Alone		**Crowded**	
	Mean reaction time (secs.)	**Sd.**	**Mean reaction time (secs.)**	**Sd.**
PC (N=34)	5.58	.87	4.37	.92
iPAC (N=34)	5.54	1.55	6.23	2.33

Table 9.7: Mean reaction time to all on screen information

The ANOVA revealed no significant effect of reaction time in responding to on screen statements in the alone and crowded conditions F (1,67) = .501, p=0.482. The ANOVA revealed a significant effect of reaction time responding to on screen statements in the iPAC and PC conditions F (1,67) = 5.994, p< .05. Response time was significantly faster in the PC conditions compared to the iPAC conditions.

The ANOVA revealed a significant interaction effect of reaction time between the alone and crowded conditions and the type of device use $F(1,67) = 6.536$, $p < .05$. This suggests reaction time becomes faster when in a crowded situation and dealing with information on a PC compared to reaction time slowing when undertaking the same task on an iPAC device in a crowded situation.

9.9.4 Heart rate response to types of questions

To compare any difference in heart rate between the four types of questions means were calculated. No statistical analysis was made due to the fact different types of information may appear more embarrassing to one individual compared to another. Also as the statements were presented randomly this resulted in rather large unequal sample sizes.

9.9.4.1 Personal information

The mean heart rate related to the personal questions between the four conditions revealed the following iPAC (89.45 BPM), PC (90.55 BPM), crowded (88.07 BPM) and alone (91.40). There appears only slight variation between all four means. Therefore receiving personal information when alone or in a crowded situation on either an iPAC or a PC appears to have the same affect on heart rate.

9.9.4.2 Financial information

The mean heart rate related to the financial questions between the four conditions revealed the following iPAC (90.32 BPM), PC (90.77 BPM), crowded (97.90 BPM) and alone (83.93). Again there appears a slight trend towards increase in heart rate in the crowded condition compared to the other three. This implies dealing with financial information in a crowd is more stressful to when alone.

9.9.4.3 Self-knowledge information

The mean heart rate related to the self-knowledge questions between the four conditions revealed the following iPAC (90.00 BPM), PC (103.97 BPM), crowded (100.81 BPM) and alone (93.37 BPM). Again a slight trend in increased heart rate appears when dealing with information about the self when in a crowd or when using a PC.

9.9.4.4 Health information

The mean heart rate related to the health questions between the four conditions revealed the following iPAC alone (87.42 BPM), iPAC crowded (82.59 BPM), PC alone (89.55 BPM) and PC crowded (114.60 BPM). The means and standard deviations for the health statements are depicted in Table 9.8.

	Alone			**Crowded**		
	Mean heart rate (BPM)	**Sd.**	**N**	**Mean heart rate (BPM)**	**Sd.**	**N**
PC	89.55	29.48	14	114.60	25.19	13
iPAC	87.43	30.45	14	82.59	31.78	12

Table 9.8: Mean heart rate response to health related questions

Comparison of the means reveals heart rate increased when participants were receiving health related information in the PC crowded condition compared to the other conditions. This suggests dealing with health related information on a PC in a crowded situation is stressful.

9.9.5 Questionnaire ratings for privacy of device

The ratings for privacy between the conditions were PC (3.12), iPAC (4.65) alone (4.11) and crowded (3.65). The means and standard deviations are shown in Table 9.9.

	Alone		**Crowded**	
	Mean privacy rating	**Sd.**	**Mean privacy rating**	**Sd.**
PC (N=34)	3.06	1.10	3.18	1.52
iPAC (N=34)	5.16	1.20	4.13	1.52

Table 9.9: Mean rating for privacy for each condition and type of device

There was a significant difference between ratings of privacy and device used $F(1,67)=21.777$, $p < .001$. The iPAC was rated more private for dealing with personal information compared to the PC.

There was no significant difference between privacy ratings between the alone and crowded conditions, $F(1,67) = 1.960$, $p=0.166$. Therefore when alone or in a crowded situation ratings of privacy do not differ.

There was no interaction effect of device type and the alone/crowded conditions for ratings of privacy, $F(1, 67) = 5.649$, $p=0.083$.

9.9.6 Clarity of screen information

The ratings for clarity of on screen information between the conditions were iPAC (5.11), PC (4.59), crowded (4.46) and alone (5.25). The means and standard deviations for clarity of on screen information between the conditions are shown in Table 9.10.

	Alone		Crowded	
	Mean clarity rating	**Sd.**	**Mean clarity rating**	**Sd.**
PC (N=34)	5.14	.64	4.04	1.41
iPAC (N=34)	5.35	1.21	4.88	1.38

Table 9.10: Mean rating for clarity of information for each condition and type of device

There was a significant difference between ratings for clarity of on screen information between the alone and crowded conditions $F(1,67) = 7.183$, $p < .05$. Clarity of information was rated clearer in the alone condition compared to the crowded condition.

There was no significant difference in rating clarity of on screen information between the iPAC and the PC conditions, $F(1,67) = 3.216$, $p=0.078$.

There was no interaction effect of device type and the alone/crowded conditions when rating clarity of information, $F(1, 67) = 1.141$, $p=0.290$.

9.9.7 Attitude towards each device

The ratings for attitude towards the four different conditions were iPAC (5.47), PC (4.42) crowded (4.47) and alone (5.42). The means and standard deviations for overall attitude towards each device and alone/crowded conditions are shown in Table 9.11.

	Alone		Crowded	
	Mean attitude rating	**Sd.**	**Mean attitude rating**	**Sd.**
PC (N=34)	4.97	1.36	3.88	1.28
iPAC (N=34)	5.88	1.03	5.05	1.94

Table 9.11: Mean rating for attitude towards each device and condition

There was a significant difference between ratings for overall attitude towards the device used between the alone and crowded conditions $F(1,67) = 7.435$, $p < .05$. Attitude was rated more positively towards the devices in the alone condition compared to the crowded condition.

There was a significant difference between ratings for overall attitude towards the device used between the iPAC and PC conditions $F(1,67) = 8.871$, $p < .05$. Attitude was rated more positively towards the iPAC compared to the PC.

There was no interaction effect of device type and the alone/crowded conditions when rating attitude, $F(1, 67) = .143$, $p=0.707$.

9.10 Confederate ratings for the crowded conditions

Confederates ratings for how anxious the participants appeared in the iPAC and PC crowded conditions were 4.62 and 4.25 respectively. Therefore participants did not appear anxious when using either device. The confederate placed directly behind each participant recorded being able to see information in the PC condition on only four occasions. The amount visible ranged from all on screen information on one trial to around a quarter on two other trials. The two confederates placed at the side of each participant could see the majority of information on both devices. A breakdown of how much information confederates could see related to either the PC or iPAC conditions is shown in Table 9.12.

	Amount of information seen by confederates			
	None	**All**	**Half**	**Quarter**
PC (N=17)	0	13	3	1
IPAC (N=17)	9	2	4	2

Table 9.12: Amount of information seen by confederates in the iPAC and PC crowded conditions

Confederates noted participants made several behavioural changes in the PC and iPAC crowded conditions. Postural changes related to gestures such as participants looking behind, facial changes or changing foot position. Confederates also noted in the PC condition 4 participants turned in towards the screen as if to hide the information. In the iPAC 6 participants actually tilted the device towards their body as if to hide what was on screen. Table 9.13 shows the type and amount of behavioural changes made in either the PC or iPAC conditions.

	Behavioural changes			
	None	**Postural**	**Turned towards screen**	**Tilted iPAC towards body**
PC (N=17)	6	7	4	0
IPAC (N=17)	3	8	0	6

Table 9.13: Amount of behavioural changes in the iPAC and PC crowded conditions recorded by confederates

9.11 Summary of key findings

- Significant increases in heart rate occur when receiving information when in a crowd compared to when alone
- Significant increases in heart rate occur when dealing with information on a PC compared to on an iPAC device
- Heart rate increases more when dealing with health information in crowded situation and when using a PC device compared to when alone and using an iPAC device
- Reaction time to all types of information is faster when using a PC compared to using an iPAC device
- In the iPAC condition the interaction is rated as more private compared to the PC condition
- When alone the clarity of information is rated significantly clearer compared to when in a crowd
- In the alone condition attitude towards the device is more positive compared to the crowded condition. Also attitude towards the device is rated significantly more positively for the iPAC compared to overall attitude towards the PC

9.12 Discussion

The three key challenges outlined in the introduction to this study have been met. The first challenge was to establish if dealing with personal information in a crowd was more stressful compared to dealing with personal information when alone. Results show dealing with personal information in a crowd is more stressful and this is reflected in the increased heart rate of participants. The second challenge considered whether the type of device used resulted in a more aroused state. Findings show dealing with information on a PC is more stressful compared to dealing with information on an iPAC. The final challenge was to explore if increases in levels of arousal were associated with different types of information. Results indicate when dealing with health information arousal levels increase more when using a PC in a crowd compared to using an iPAC in a crowd. These findings are discussed in more detail in the following sections.

9.12.1 Contextual affects when accessing information

Context again emerged as a key variable that affects use of technology. Previous findings in this thesis have highlighted how context affects ATM use in public places. Although this study was undertaken in a lab the findings can still be generalised to technology use in public places. The results from this study provide empirical evidence that crowding has a major impact on the users levels of arousal. Participant's heart rate increased significantly in comparison to their baseline heart rate when dealing with information in both the alone and crowded conditions. This suggests accessing any type of information and on any device is a stressful event. This finding is interesting as it implicates dealing with information is actually a physical stressor. When participants were dealing with information in the crowded condition their heart rate was significantly higher compared to when alone. This indicates how crowding can increase stress in particular when using technology to access personal information.

9.12.1.1 Interacting with strangers

Previous research has found little support for any change in heart rate when individuals' personal space has been violated. In this study participants were told their personal space would not be intruded upon. Participants were informed the 'confederates' would be trying to see as much on-screen information as possible but at the same time would maintain a minimal distance of approximately one metre. The findings from this study reveal how other people's presence in the immediate environment can influence users of technology. Other people's presence can make users feel uncomfortable and this can result in increased heart rate as found in this study. The results support previous research in that environmental stressors like crowding increase stress.

The findings also support the linkage between stress and reduced behavioural control (Sundstrom 1978), unwanted uncontrollable interaction (Baum & Valins 1977), excessive stimulation or social overload syndrome (Saegert 1978). Excessive stimulation may explain the results in this study. Participants' perceptions were that the on screen information was going to be personally related to them, they had to rate the information for how personal they believed it to be and at the same time in the crowded conditions had to somehow protect the information from other people's view.

As there were only three confederates in the crowded condition the results support the view of Zayan (1991) in that it may not be crowding as such that increases stress but the presence of strangers. Strangers can therefore be classed as social stressors who in turn make individuals' interaction with technology uncomfortable especially when the users are dealing with personal information.

Latané (1991) stated people's reaction to crowding is associated with change in physiological states and subjective feelings, motives, emotions, cognitions and beliefs, values and behaviours. These changes occur as a result of the real implied or imagined presence or actions by other individuals. The findings from this study support this view. When in crowded conditions participants' heart rates increased and they made more behavioural changes. These findings support previous research in that people make more postural changes in crowded conditions (Sundstrom 1975) and when faced with a stressor the body reacts by making physiological changes i.e. increased heart rate (Selye 1936). The findings highlight how the presence of others can influence an individual's behaviour in many ways. Their actions and expectations can exert a strong control over how an individual reacts to any situation.

9.12.1.2 Does the device make a difference?

As discussed earlier mobile devices free the user and therefore context can become a more dynamic interaction. Although participants in this study were not free to move around the size of the device and interface did allow for more privacy compared to users in the PC condition. Changes in heart rate increased significantly from baseline measures on both devices however the largest rise did occur in the PC condition. This is interesting as the increase in heart rate may in part be due to the actual interaction with the technology itself. All participants seemed competent and confident users of IT. All participants were fully briefed about how to use both devices, only a few stated they had never used an iPAC device before. Therefore although the iPAC device to some may have been novel this cannot explain the rise in heart rate from the baseline measures in the iPAC alone and crowded conditions.

9.12.1.3 Information exchange and related task

Previous research highlights complex tasks increase heart rate compared to simple tasks. The task carried out by participants in this study was simple however heart rate still increased dramatically in nearly all conditions. Participants had to passively cope by rating the on screen information they were presented with. Previous research (e.g. William 1986, Sawada 1993) suggest passive coping does not increase heart rate enough to warrant any significant change compared to when individuals have to cope actively. The findings in this study do not support these views. This study purports that whether people use a passive or active coping mechanism to deal with a stressor the amount of physiological changes will be dependent upon context.

The results from this study support previous findings discussed in chapter eight in that individuals view health information as more personal. Health information was rated as more personal in the PC crowded condition compared to the other three. This finding highlights when users are presented with information their perceptions can be altered by the type of device they have used. This reveals important implications for design and placement of health information kiosks.

Participants in this study reacted faster to all types of information on screen in the PC condition compared to the iPAC condition. The reaction times for both PC and iPAC alone conditions were similar. Surprisingly the slowest reaction time to on screen information was in the iPAC crowded this may be a result of having to use a pen device for rating purposes compared to the click of a mouse in the PC condition.

After the initial trials and before participants were debriefed they rated the device used for privacy, clarity of screen information and their overall attitude towards it. The use of the iPAC was rated as the more private for dealing with personal information compared to the PC. The clarity of on screen information was rated clearer in the alone condition compared to the crowded condition. This is interesting as the information was presented in the same format in all conditions apart from the actual size of the screen. Therefore one would expect clarity of information to be rated clearer in both PC conditions due to the size of the screen. Participants in the PC and iPAC crowded rated the clarity of on screen information as less clear compared to participants in both alone conditions. This again highlights users perceptions of devices can be negatively influenced by other people in the immediate environment. Overall attitude towards the device was rated more positive in the alone and iPAC conditions compared to the PC alone and PC crowded condition. This again reveals how users feel more comfortable dealing with personal information when alone and on small handheld devices.

9.12.1.4 Physiological v subjective response

Findings from this research support work by Wilson & Sasse (2001) in that physiological responses occur when using devices the user is not aware of. In this study participants' heart rate increased significantly when dealing with personal information across the four conditions but their subjective ratings of privacy remained constant. This is interesting as one would predict the more the aroused state of the participant the more he or she would perceive the information to be of a personal nature and therefore rate it accordingly. In line with Wilson & Sasse this thesis purports some affective responses often occur unconsciously when someone is using technology and therefore need further investigation.

9.13 Implications

- Service providers need to give careful consideration to the type of task the system will be used for
- Placement of systems needs careful consideration
- The environment must support the intended system use
- Deliberation needs to be made over whether handheld devices could be used instead of static systems for accessing personal information in particular when health related
- When someone is using a device for accessing personal information other people in the immediate vicinity must give the user plenty of space

9.14 Chapter Summary

When considering systems used in public areas in particular ones that are used to access personal information the actual type of device, its design and the size of the interface need careful consideration. Findings from the first study reported in this chapter reveal how slight changes in design to a system can increase users perceived levels of privacy. The results from the second study provide empirical evidence that dealing with personal information is not only stressful in a crowd but can also be uncomfortable on both static and mobile systems. The second study highlighted how both socio-environmental factors and technological systems cause problems for users and in turn make the interaction uncomfortable. Prolonged psychosocial stress factors play a significant role in the onset and progression of stress-related disorders (Sgoifo et al 2003). This latter statement is rather worrying when related to the findings of the second study. Especially when users appear unaware of any change in their physiological state. In today's world people use technology to access a host of different information, if accessing the information is stressful what are the implications for individual's long-term health? Designers and service providers need to consider these findings if their intention is to create future systems where human interaction is efficient, effective and satisfying. Users need to be considered all through the design process and consideration needs to be given to what the device will be used for and where.

Chapter 10

Conclusions and Future Work

In the final chapter the thesis work is discussed along with consideration for future work. A set of design guidelines for public space technologies is described in this chapter. A short review of the chapters is set out indicating where the specific objectives have been met and the important results. The validity of TAMPS is discussed in relation to the variables in the model and to technology use in public areas. Context is briefly revisited and VASc reviewed. The importance of socio-environmental factors is further emphasised in a brief discussion related to developing future systems. The chapter concludes with suggestions for future work and final conclusions made.

10 Thesis summary and conclusions

The aim of this thesis was to find the factors that influence the use of technology in public spaces from the users perspective. This included examining the ways humans interact not only with technological systems used in public areas but also human – human interaction in such places. The aim has been achieved and a number of specific objectives met. The thesis has identified socio-environmental factors have a direct influence on technology use in public places. To analyse the factors a valid and reliable psychometric tool was developed and applied to two types of technologies i.e. ATMs and mobile telephones. This thesis has integrated factors associated with technological adoption and environmental influences on behaviour. This thesis has noted and verified the importance of context and that it is a key variable when considering interaction with technology in public areas. The review in chapter one outlined very little of the HCI or psychological literature considers human interaction with technology in public spaces. Suggestions were also made that existing methods and approaches need expanding to account for social and environmental influences with regard to technology use in public areas. The work in this thesis has resulted in a comprehensive, global picture of factors and problems that influence use of technology in public zones. The findings have identified how different contexts for users of public space technologies can be constrained by various problems and social pressures. The thesis has developed a valid psychometric tool for measuring those influences along with TAMPS that offers a framework for evaluation.

This thesis has noted if designers and service providers are to be successful in evaluating or facilitating adoption and use of ubiquitous and mobile devices they need to acknowledge that social and environmental factors influence use. A set of general guidelines has been produced related to the findings in this thesis that should be considered in the design process. If followed, these guidelines will help designers ensure users perceive the end product as effective, efficient and satisfying. Table 10.1 provides a list of guidelines related to the design and placement of technologies used in public areas.

Guidelines	
Concept	**Design Rule**
User	Consider user population and their characteristics e.g. age, gender, culture, personality, experience and expectations.
Privacy	Design for privacy according to the needs of the user. If the system is one for dealing with personal or financial information users will need more privacy. Obtained by installing and designing systems with smaller interfaces, added side partitions, using privacy screens as standard.
Space	The area the system is used in must afford enough space both personal and non-personal. Understand space as a direct effect on users perceptions of privacy and safety.
Safety	To increase safety systems must be located in areas that are not excessively open, isolated or visible. Where possible install systems internally to increase safety.
Time Pressure	Reduce time pressure on the user by installing two or more systems.
Ease of Use	Public space technologies must always be designed for ease of use e.g. touch screens as standard. Consider whether handheld devices would be easier and more appropriate to use compared to static systems.
Usefulness	Differentiate between the services provided, certain design aspects and where the system is located. a) Service provision: consider the type of task the system will be used for, determine whether product integration is needed and useful, consider if 24/7 access is required. b) Design aspects: ensure interface is well lit, reduce any aspect that may draw attention to the user e.g. button noise, add point of contact for help and advice. c) Location: focus on accessibility, place conveniently in well-lit areas, if possible cover by CCTV, and acknowledge the immediate environment must support use of the intended system.
Context	Consider the different contexts the system will be used in. Determine the impact of temporal effects. Friendly advertising around the system might encourage appropriate behaviours e.g. giving the user enough space, reduce time pressure.

Figure 10.1: General guidelines related to the design and placement of technologies used in public areas

In the remainder of this chapter a review of the thesis work is presented indicating where the objectives of the thesis have been met and highlighting the important results. The main variables included in TAMPS are reviewed along with contextual constraints. A brief discussion is made in relation to the findings of this thesis and future systems. Further work is considered and final conclusions drawn.

10.1 Chapter Reviews

The central argument of this thesis was outlined in chapter one in that socio-environmental factors influence the use of technology in public places. The thesis work arises from the recognition of the expanding role of technology within social interaction. The review highlighted very little of the HCI or psychological literature has considered the interaction between people and technology in public spaces. The discussion highlighted how the use of technology pervades every part of social interaction. Two scenarios were used as evidence that different interactions with different devices are constrained by time and place. The debate considered the non-verbal behaviour of personal space and the concept of privacy as main variables that influence both social interaction and technology use in public areas. Reference was made to Yuan et al's (2003) argument that effective technology use needs evaluation strategies that are able to capture and assess problems that go beyond the technology itself. This thesis has developed new ways to conceptualise and study interaction in public places and relate findings to new technologies.

The literature review in chapters two and three documented and discussed how attitudes and socio-environmental factors are implicated in the use of technology. Emphasis for the need to understand current system use to be able to design systems successfully for future use was established. A key challenge was identified in that the HCI community needs to develop theory and tools capable of assessing social influence on technology use. The review of the Technology Acceptance Model highlighted how attitudes have been integrated into HCI research. Evidence was presented that revealed how TAM has been successfully expanded by inclusion in the model of external variables that have a direct effect on attitudes and intention to use a technological system. The discussion in chapter three showed how environmental and social influences are intrinsically linked and how they are implicated in technology use. The review considered privacy and personal space as important variables that affect the level of social interaction and the use of technology. The debate highlighted privacy research lacks consensus regarding different dimensions, functions and definitions of what the environment actually exists of.

Although exploratory the research in chapter four successfully combined HCI and psychological approaches to further understand human interaction with technological systems. The research explored, evaluated and considered how external variables fit in relation to TAM and actually what variables affect use of public space technologies. Main findings suggested four variables were significant in predicting future use of ATMs:

- Specific privacy – related to the individuals beliefs about their level of perceived privacy for the technology used at that particular point in time
- General privacy – related to the individuals beliefs and experience about their level of perceived privacy for technology use in general
- Anxiety – the level of anxiety an individuals feels when they are using technology

- Experience – the level of experience an individual has of using a particular type of technology

Deliberation was made of how these external variables fit with TAM and have a direct effect on use. These findings highlighted TAM needs expanded to account for social influence.

The in-depth qualitative approach in chapter five put the user at the heart of the research agenda. Several personal and non-personal constructs emerged from the analysis. ATM use was influenced by personal constructs: privacy, space, safety and time pressure. Non–personal constructs related to ease of use, usefulness and location. The findings highlighted how space is a very important mechanism for controlling ATM users' privacy. Time pressure from other people in the immediate vicinity emerged as a key variable that influences system use.

The research carried out in chapters six and seven helped quantify findings and development a valid and reliable psychometric tool. The tool measures the influence of socio-environmental factors on the use of technology in public places. The process of developing a valid and psychometric tool was presented in chapter six. The factor analysis applied to the questionnaire revealed five components that provided a homogeneous set of variables that influence system use. Key findings from the SEM analysis showed response towards the use of technology in public places is more complex than existing models of technology acceptance such as TAM. The Technology Acceptance Model for Public Space Technologies (TAMPS) was proposed as a model that can be used to assess and measure the use of technology in public areas. Implications for design and placement of ATMs were discussed. The implications highlighted how if use of a system is going to be effective, efficient and satisfying the following considerations must be made: the immediate environment must support the intended use of the system, ATMs should be placed in environments that afford privacy, space and safety, design specification must consider the number of people around at the time of system use, the user population and their characteristics and the type of task the system is to be used for.

A shortened version of the questionnaire was developed in chapter seven. Findings verified the validity and reliability of the shortened version. The research demonstrated how the tool was applied successfully to measure factors that influence use of two different technologies, ATMs and mobile telephones.

In both chapters six and eight this thesis provided evidence of how existing methods and approaches in HCI can be further developed and expanded successfully. The development of TAMPS and the application of Activity Theory to understand the use of existing technologies. In using an Activity Theory approach in the research conducted in chapter eight the findings emphasised the need to consider both internal and external influences on the user and consider different contexts are often constrained by time and place. The research in chapter eight explored how context affects use. The research demonstrated how Videotaped Activity Scenarios (VASc) can be scripted from interviews and used very effectively to promote focussed discussion around the topic of interest. The study demonstrates how discussions can be successfully interpreted using a thematic analysis and integrated into Engeström's framework of human activity. The methodological process employed led to verification of those contextual factors that influence the use of an ATM in a public space. The findings also provided evidence that Activity Theory and VASc can be used to develop understanding of problems inherent in the use of public space technologies.

Findings from the research in chapter nine justified that designers and service providers need to consider not only usability issues but also their user population, their characteristics, the environment and the task the system will be used for. The thesis work identified how slight changes in the design of a system can subtly increase users perceived levels of privacy by adding side partitions to screens. This thesis found empirical evidence that dealing with personal information on a system in crowded conditions is more stressful compared to dealing with personal information compared to when alone.

The review has indicated where the objectives of the thesis have been met and highlighted the importance of the results. The influence socio-environmental factors have on technology use in public spaces has been explored and characterised using the TAMPS model developed in chapter six. Use of both static and mobile systems have been examined using the model to find how those factors influence attitude and intention. Where appropriate implications for designers and service providers have been presented at the end of each chapter.

10.2 Assessment and validation of the questionnaire

The questionnaire was developed with the intention of being able to characterise and measure factors that influence the use of technology in public places. The 24-item questionnaire provides a short concise homogeneous set of variables that measure factors that influence technology use on public areas. The questionnaire can be used to measure system use and then results can be applied to TAMPS.

A step-by-step process was involved in the development of the questionnaire that has led to a reliable and valid psychometric tool. The process involved initial interviews with 20 ATM users and from this concepts such as privacy and space emerged. Where possible questions were drawn from existing literature and research e.g. Davis (1989), Pedersen (1999). The use of a pre-test categorisation method by a sample representative of the target population has helped strengthen the construct validity of the questionnaire. The initial 45-item questionnaire involved a sample of 307 participants which was used to assess the reliability and validity of the scale. The scale was further refined to a 24-item shortened version through factor analysis and reliability procedures. The survey was conducted involving over 500 participants via the Internet. This provided further evidence of the robustness of the questionnaire as a tool to measure how socio-environmental and usability factors influence use of different static and mobile technologies. Data was then used to assess the relationship between privacy, space, safety, time pressure, ease of use and usefulness on attitude and intention towards use of a system. The relationship was developed into the TAMPS model.

The questionnaire is a useful tool for measuring how both socio-environmental and usability factors influence adoption and use of public space technologies. The questionnaire is a valuable tool that can be used at any stage of the design process, e.g. to evaluate existing as well as new systems. Designers can employ the tool to explain user interactions and to evaluate user perceptions directly from the target population of interest. Findings will inform designers how to avoid or eliminate problems for users of technology in public places.

10.2.1 Assessment and validation TAMPS

The TAMPS model has been validated by the research carried out in chapters six and seven of this thesis. The model has been developed with the intention of being able to characterise and measure factors that influence the use of technology in public places. TAMPS provides a homogeneous set of variables that measure factors that influence technology use in public areas. The questionnaire can be used to measure system use and then results applied to TAMPS. This allows a detailed and specific framework to visualise how the use of technology in public places is influenced by both socio-environmental and usability factors. The model can be used to measure both static and mobile technologies. In this thesis use of both types of systems have been successfully characterised using TAMPS.

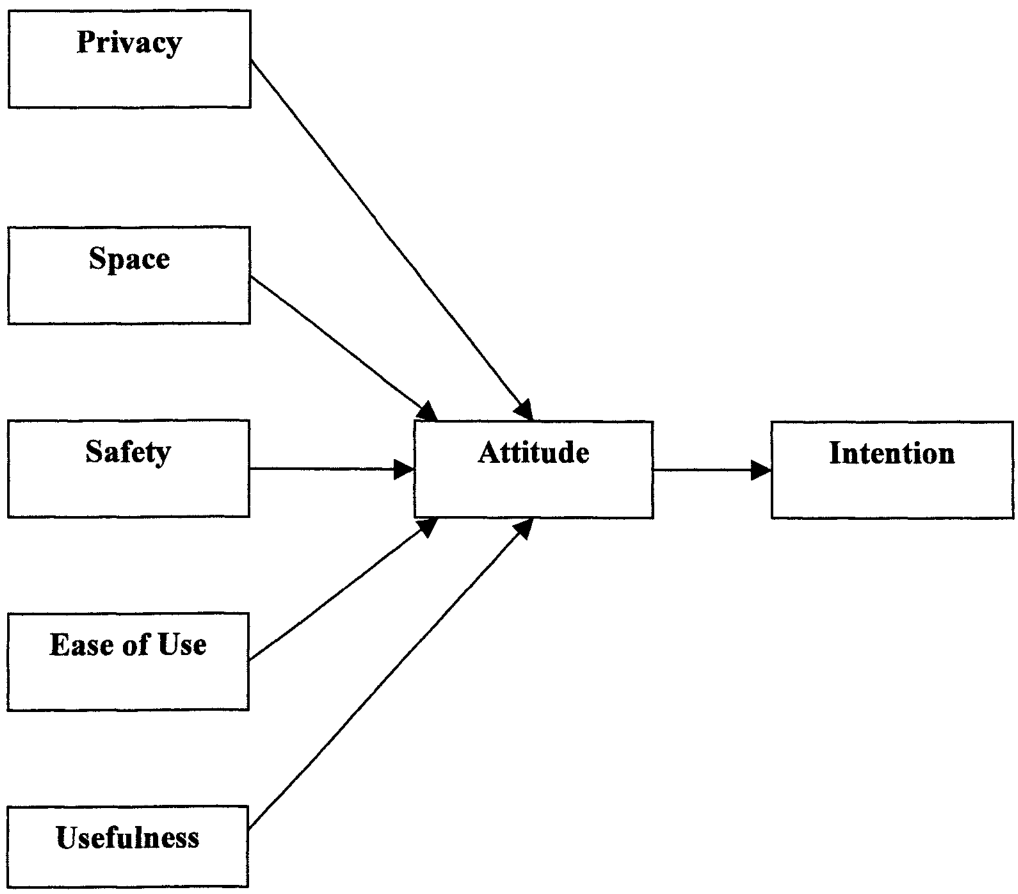

Figure 10.1: Technology Acceptance Model for Public Space Technologies depicting the main variables: privacy, space, safety, ease of use and usefulness.

Each heading of the model is now assessed and the main findings from the studies are presented. Finally its effectiveness as a method for understanding system use is assessed and the issue of whether both the questionnaire and model has been validated is addressed.

10.2.2 Revisiting privacy

This thesis has provided empirical evidence the concept of privacy is an important variable influencing the use of technology in public places. The review in chapter 3 highlighted privacy research suffers from lack of consensus in particular when related to the dimensions and functions of existing privacy models. The review highlighted the majority of HCI literature on privacy tends to focus on information and control of information over the Internet. This thesis has identified the importance of 'physical privacy' as a major concept implicated in technology use in public areas.

The privacy component of TAMPS was analysed using measures from existing models of privacy i.e. Pedersen and Burgoon. Findings in this thesis have identified problems with these existing models. Pedersen identifies solitude, reserve, isolation and anonymity as types of privacy that are independent of each other. However when applying the specific types of privacy to research there appears a vast overlap, this was discussed in chapter 6. Differentiating between solitude and isolation as distinct types is impossible and also with reserve and anonymity. Pedersen does acknowledge his model needs to be empirically validated. However the proposed functions and types ignore physical privacy. Both Pedersen's and Burgoon's models only describe how privacy is maintained in controlled interactions and environments. Palen & Dourish (2003) argue regulation of privacy is a dynamic process with variable boundaries, under continuous negotiation and management, continuously refined according to circumstance. This thesis supports this view.

10.2.3 Space as a control mechanism

Chan (2000) purports the ability to manipulate space is the primary way individuals achieve privacy. This thesis supports this view. The concept of space in TAMPS reflects the need for users to protect, control, communicate and regulate the level of interaction with others. This thesis purports the degree of space needed when interacting with technology in public places is task dependent and not solely based upon high density.

10.2.4 Safety

People need a certain level of security and comfort from their immediate environment (Valentine 2001). The concept of safety in TAMPS acknowledges users of technology in public places have only temporary control over their immediate environment. Almost anyone can gain access. Previous research (e.g. Ruback et al 1989) has proposed people will persist on a task in a public area if no alternate resources are nearby. This thesis has found empirical evidence that when someone is using technology in a public area, in particular an ATM other people in the immediate environment reduce the users perceived level of safety. This in turn inhibits the user undertaking more than one task on the device even if there are no alternate ATMs nearby.

Holt & Spencer (2004) argue the area around an ATM is good for targeting victims in relation to crime. They purport users are generally cash rich, distracted by the task of withdrawing money and less likely to take account of their immediate surroundings. However this thesis purports users are more aware in certain environments, contexts and the task at hand.

Previous research on defensible space that relates to crime and security suggest the need for openness and visibility (Lawson 2001). This thesis suggests the area around an ATM can be too open and visible and users then perceive a higher risk of crime. Recent research by Holt & Spencer (2004) into crime prevention at ATMs in

Manchester, UK indicated a one metre painted square around machines reduces street crime. They suggest the painted square provides an area of 'personal defensible space'. This in turn makes the area hostile to uninvited intruders, allows the user to have more control and be more aware whilst carrying out his or her transaction. They suggest this idea also impacts upon other people waiting to use the ATM, as they do not invade the demarcated square zone when someone is using the machine.

10.2.5 Perceived Usefulness and perceived ease of use

Perceived usefulness (PU) and perceived ease of use (PEOU) components in TAMPS are based on the original TAM proposed by Davis (1989). Davis found strong correlations between PU and PEOU. He purported if PU was controlled for then PEOU does not have an affect on system use. He further postulated PU was the strongest predictor of intention. Also frequency and familiarity with the system decreased any influence on PEOU over time. However Davis postulated this is dependent on the complexity of the system. Therefore according to TAM PU would be the best predictor of both ATM and mobile telephone use as they are not complex systems. The findings in this thesis oppose this view. PEOU has emerged as a greater predictor of system use than PU.

10.2.6 Attitude and intention

The thesis work provides empirical evidence that both attitude and intention are crucial variables when measuring technology use in public areas and therefore both need to be included in future work. TAMPS incorporates both variables in the model. This thesis has provided evidence that social norms and situational factors can conflict with a person's attitude and therefore have important implications on his or her behaviour. The original TAM supported a link between attitudes, intentions and behaviour. Davis et al (1989) later dropped attitude from the model as intention was purported to be the main variable of interest. This thesis purports attitude to be a major variable that helps measure and understand system use and therefore inclusion critical. The key to why Davis dropped attitude may well be associated to the fact his research was based on system use in the workplace where use was mandatory. This is not enough to explain technology use in public areas where social influence is a lot stronger and therefore a user's attitude towards the device is more relevant. Measuring both attitude and intention helps our understanding of how people perceive, interpret and interact with technology.

10.2.7 Summary and implications

The questionnaire and TAMPS have been successful in analysing socio-environmental and usability factors on use of technology in public places. This thesis is the first to quantify those factors that influence use of public space technologies. The model has been a very useful tool in exploring the concept of socio-environmental factors on the use of technology in public spaces and has allowed an explicit examination of those variables and how they influence use. TAMPS has helped to reveal and explore the complex interrelationship socio-environmental and usability factors have on the use of such publicly used technologies.

The model has allowed comparisons between both static and mobile devices drawn in terms of five main variables. It has focused attention on how those factors influence use directly and how service providers and designers can model future system design. TAMPS provides a new way for the HCI research community to conceptualise and evaluate their decisions. In addition TAMPS suggests new ways of guiding the design process of future systems.

10.3 Contextual constraints

This thesis has successfully examined how context influences the use of technology in public areas. The research in chapter eight demonstrated how exiting approaches like Activity Theory can be used and expanded successfully to account for social influence on existing technologies, in this case ATMs.

The innovative development of VASc further developed our understanding of problems inherent in the use of public space technologies. VASc can be used as a verification tool for qualitative work and evaluating future system design and use. Future systems will be embedded into nearly every artefact imaginable and information between these systems will be exchanged without the user actually being aware of the process. VASc would therefore be an excellent tool to evaluate how technologies might be used in the future, prospective users could generate rules related to what type of information should and should not be exchanged between devices.

This thesis has provided evidence that users of systems can help designers and service providers improve the quality of public space technologies by the generation of rules. Rules that are easily generated by focused discussion by actual users and enhanced by their personal experiences.

The perception of public space systems especially ATMs are they offer a quick and reliable walk up and use service. Industries current focus is on one of product integration. This thesis has uncovered users of ATMS perceive social pressure from other people in the immediate environment to be problematic. Rules generated indicated a need for 'cash only' ATMs to alleviate the negative effects of queues. Industry needs to consider these findings and give careful consideration to what and where they incorporate into integrated systems. This thesis has provided empirical evidence when dealing with personal information on devices in crowded situations it is more stressful compared to undertaking the same task alone. The type of information the user is presented with can also have an adverse effect when interacting with the device. Findings indicate even when passively coping with information users find the activity stressful.

As the future is one of product integration with anytime anyplace access designers and service providers need to consider the effects of prolonged psychosocial stress. The intention should be to create future systems where human interaction is efficient, effective and satisfying and not just purely based on accessibility and usability. This thesis has suggested design of public space systems is based on accessibility. Findings indicate privacy needs to be included in the design process. As found in chapter nine screen size and type can dynamically change users perceptions of privacy. All through the design process consideration needs to be given to existing and potential users, what the device will be used for and where.

10.4 Success in system use

Emerging technologies will transform both communication and lifestyle. Success of any innovation depends to a great extent on the acceptance of new products as well as adoption (Pepermans, Verleye & Cappellen 1996). This thesis has found empirical evidence that socio-environmental factors influence technology use in public areas. If future ubiquitous and ambient systems are to be successful then acknowledgement must be given to how those factors influence current use.

One way to facilitate adoption is to increase awareness of the benefits of using a system. As discussed in chapter one of this thesis there is now a growing trend to integrate the functionality on static and mobile systems. Product integration will lead to new ways of interacting with devices. The findings in this thesis suggest that if designers and service providers alike consider those socio-environmental factors found to influence use systems will be effective, efficient and satisfying to use.

Early research on using self-service technologies focused on customer concerns in accepting ATMs as an alternative to human tellers (e.g. Abell 1980). Some users now prefer to use self-service technologies to avoid any social interaction with employees (Dabholtakar 1996). Industry and service providers now acknowledge systems need to appeal to all existing and potential customers and therefore promote use. The key challenge for designers and service providers of public technologies is how to accommodate a vast range of potential users (Hone et al 1998). Self-service technologies are increasingly being used to disseminate, access, process and collect information and to perform transactions both financial and non-financial. Meuter et al (2003) purport the marketplace is being replaced by the marketspace, a virtual arena where transactions take place through technological channels. If this is the key to future human interaction with technology then factors such as privacy need careful consideration. The HCI community need to develop tools and methods such as those proposed in this thesis to account for socio-environmental influences on use. Methods that incorporate both virtual and physical worlds. Already users of most technologies leave data trails behind that are both personal and private. With the growth in information exchange not only between individuals but devices the large invisible audience accessing the information is set to grow.

10.5 Future work

This thesis identifies three main areas for future research. These are the development of a robust model of privacy, the provision of a valid psychometric tool to measure individual differences when related to technology use in public areas and the need to further consider context.

10.5.1 Privacy model

As discussed earlier with the development of ubiquitous and ambient technologies the HCI community needs to develop a robust model of privacy. The model needs to account for privacy and information exchange in both virtual and physical worlds. Informational and physical types of privacy need to be at the heart of the model. This thesis has found empirical evidence that privacy is an important human need when interacting with technology in public places. The thesis also purports space is an important control mechanism used to achieve a desired level of privacy. Therefore a comprehensive description is needed that explains how users of technological systems will control personal information in the virtual world at the same time control unwanted input in the physical world. Development of such a model is crucial in not only predicting current use but in developing systems successfully.

10.5.2 Accounting for individual differences

In designing new systems for anywhere anytime use it is important to consider the issue of individual differences. Although exploratory the research in chapter seven highlighted personality traits e.g. extroversion, novelty seeking as having an influence on use of both ATMs and mobile telephones. If future technologies are to be successful a psychometric tool needs to be developed that measures individual differences and technology use. Personalisation of services is already underway. If service providers know their user's personality they will be able to deliver the correct personalised information in a timely and appropriate fashion. The future may see systems designed with the individual user participating in the design process, indicating what services or gadgets he or she would like incorporated into his or her own device. Radio frequency tags incorporated into clothing could alert providers of services that person A is extroverted and would be content to receive the latest celebrity gossip on his or her mobile device while person B does not.

10.5.3 Overall limitations

Certain limitations of the research carried out in this thesis need to be addressed. Inter-rater-reliability would have improved findings related to the observational study in chapter 4 and the qualitative studies in chapters 5 and 8. The research related to personality traits in chapter 7 would have yielded less problematic findings if an existing questionnaire had been used. Individual differences such as age and gender could have been either explored or controlled for in the studies reported in chapters 6, 7 and 9. This may have uncovered any issues or problems related to age and/or gender differences. The use of questionnaires in research relies on subjective responses therefore further experimental work would have enhanced the findings in this thesis. For example, conducting an experimental study in a public place would have been advantageous.

10.5.4 Context for future interaction

This thesis has highlighted the importance of context on technology use in public areas. Findings indicate different contexts of use are constrained by various problems and social pressures. When considering future technologies the HCI community, designers and service providers alike need to consider the actual environment and context the system will be used in. Future work needs to fully account for context and the actual environment. Also exactly what the system will be used for needs to be considered. This will allow technologies and the available services to be designed specifically for the needs of the user.

10.6 Final conclusions

The main thesis aim of finding the factors that influence use of technology in public places from the users perspective has been achieved. The development of a valid, reliable psychometric tool, TAMPS and VASc has allowed a detailed examination and exploration of how socio-environmental factors influence the use of technology in public places. Rather than focus purely on accessibility and usability factors this thesis has enabled the integration of privacy, space, safety, ease of use and usefulness. This thesis has examined and considered the importance of contextual influences on use of public space technologies. Existing methods and guidelines related to the use of technology fail to consider socio-environmental factors. The work presented in this thesis has highlighted the importance of such variables as privacy and personal space when related system to use in public places. The future will be one of ubiquitous and ambient technologies where access to information and services is anywhere anytime. As Perry et al (2001) state anytime anywhere access may be possible it may not always be acceptable. However if the HCI community, designers and service providers integrate findings from this thesis in future system design this will lead to technology that is efficient, effective and satisfying to use.

APPENDIX A

OBSERVATIONAL RESORDING SHEET, QUESTIONNAIRE, RELIABILITY ANALSYIS AND REGRESSION ANALYSIS OUTPUT FOR THE EXPLORATORY STUDY REPORTED IN CHAPTER 4.

Observational recording sheet

1. Location:	....						
2. Density Category:	0	1	2	3	4	5	6
3. Sex:	M			F			

4. Did this person:

a) Look around while waiting?	Y/N
b) Look at the person behind?	Y/N
c) Make any form of verbal response to any one else in queue?	Y/N
d) Make any postural changes?	Y/N
e) Hide ATM while using it?	Y/N

5. Interpersonal distance:

What distance was there between others in queue?.......................................

What distance was there from the ATM user?...

6. Sex of person immediately behind in queue M/F

7) Was this person alone or with other people while waiting or using ATM?

ALONE WITH OTHERS

8) How long did their transaction take?.......................................

9) Did the person make any purchase from the Kofi stand? Y/N

Questionnaire

I am carrying out research with regard to ATM use. I would be grateful if you could spend few moments of your time answering the following questions about to your personal experience and views on using ATM's.

Would you please read and answer the following questions using a rating from 1 – 7 of how much/little that the statement applies to your personal experience or view. If any question does not relate any personal experience or views please circle not applicable – N/A on the right hand side of the questionnaire.

PLEASE CIRCLE THE NUMBER THAT MOST APPLIES TO YOU.

1. How much preference do you have for using this particular ATM compared to others?

No preference 1 2 3 4 5 6 7 high preference

2. How sure are you that other people could not see how much cash you withdrew?

Highly unlikely 1 2 3 4 5 6 7 definitely likely N/A

3. How satisfied are you at the services this ATM provides?

Not satisfied 1 2 3 4 5 6 7 highly satisfied

4. How sure are you that other people could not see the ATM screen or keys when you were using it?

Highly unlikely 1 2 3 4 5 6 7 definitely likely

5. How safe/secure does the location of this ATM seem?

Not safe 1 2 3 4 5 6 7 extremely safe

6. How sure are you that other people could not see the transaction you carried out?

Highly unlikely 1 2 3 4 5 6 7 definitely likely

7. Did you feel at all anxious while using the ATM?

Extremely anxious 1 2 3 4 5 6 7 not at all anxious

8. How useful to you is this ATM?

Not useful 1 2 3 4 5 6 7 extremely useful

9. Did you feel at ease while standing in the queue?

Very uneasy 1 2 3 4 5 6 7 extremely at ease N/A

10. Do you feel the amount of space around the ATM is sufficient when queuing?

Not at all 1 2 3 4 5 6 7 definitely enough

11. When you were using the ATM did you feel at all uneasy?

Very uneasy 1 2 3 4 5 6 7 extremely at ease

12. How would you rate this ATM for ease of use?

Very difficult 1 2 3 4 5 6 7 extremely easy

13. Do you feel the amount of space around the ATM is sufficient when using it?

Not at all 1 2 3 4 5 6 7 definitely enough

14. Do you think other people could see any of your personal information when you used the ATM?

Highly unlikely 1 2 3 4 5 6 7 extremely likely

15. Were you aware of how long the person in front of you took to use the ATM?

Not aware 1 2 3 4 5 6 7 definitely aware N/A

16. How aware are you of others around you when using the ATM?

Not at all aware 1 2 3 4 5 6 7 extremely aware

17.How aware were you of the sex of the person behind you in the queue?

Not at all aware 1 2 3 4 5 6 7 extremely aware N/A

18. Did you feel you had enough privacy when using the ATM?

Not at all 1 2 3 4 5 6 7 definitely

19. Do you think there is any risk if using this ATM on a dark evening?

Not at all 1 2 3 4 5 6 7 extreme risk

20. Did you have any problems when using the ATM?

None 1 2 3 4 5 6 7 many problems

21. How many times did you use this ATM last week?

1 2 3 4 5 6 7+

22. Would you feel at ease using an ATM for personal information e.g. loan requests, deposits in such areas as:

a) A railway station

Very uneasy 1 2 3 4 5 6 7 definitely at ease

b) A leisure centre

Very uneasy 1 2 3 4 5 6 7 definitely at ease

c) A garage

Very uneasy 1 2 3 4 5 6 7 definitely at ease

d) Your local High Street

Very uneasy 1 2 3 4 5 6 7 definitely at ease

e) A bank foyer

Very uneasy 1 2 3 4 5 6 7 definitely at ease

23. Do you prefer to use an ATM away from crowds?

Prefer crowds 1 2 3 4 5 6 7 definitely away from crowds

24. How much, if any, do you think people's privacy is threatened by recent/future changes in technology?

No threat 1 2 3 4 5 6 7 high threat

25. How would you feel about using an ATM in your local store?

Definitely not use 1 2 3 4 5 6 7 definitely would use

26. Would you prefer an enclosed area while carrying out personal transactions?

Not at all 1 2 3 4 5 6 7 definitely

27. Do you feel there is any risk involved in using an ATM?

No risk 1 2 3 4 5 6 7 very high risk

28. How would you rate as your current skill in using computers/IT?

Not at all skilled 1 2 3 4 5 6 7 extremely skilled

29. How easily do you accept changes in technology?

Difficult 1 2 3 4 5 6 7 extremely easy

30. How would you feel if a stranger started talking to you when you were using the ATM?

Very uneasy 1 2 3 4 5 6 7 very at ease

31. How quickly do you use new technology?

Never 1 2 3 4 5 6 7 immediately

32. How much money would you feel safe withdrawing from an ATM?

£20 or less £25-£50 £55-£100 £105- £150 £155-£200 £205-250 £255-£300

33. Would being recognised when using an ATM bother you at all?

Not at all 1 2 3 4 5 6 7 definitely bother me

34. Does being observed by others disturb you?

Not at all 1 2 3 4 5 6 7 definitely bothers me

35. Would you be willing to let a stranger help you use the ATM if you did not know how to carry out the task yourself?

Definitely not 1 2 3 4 5 6 7 definitely would

36. Would you feel uneasy about receiving details about your account on your mobile telephone?

Not at all 1 2 3 4 5 6 7 extremely at ease.

AGE................

SEX: MALE FEMALE

THANK YOU FOR YOUR TIME.

Regression analysis output for questionnaire in chapter 4

Descriptive Statistics

	Mean	Std. Deviation	N
FUTURE	4.2281	1.14616	57
PRIVACY1	4.1301	1.36059	57
PRIVACY2	3.8982	1.32941	57
SECURITY	3.4518	1.40744	57
AWARE	4.6264	1.10916	57
EXPER	4.4518	1.23422	57
SPACE	5.0175	1.41410	57
ANXIETY	5.3743	1.62516	57
EASEUSE	6.1491	1.31938	57
USEFUL	5.3626	1.21870	57

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.803	.645	.577	.74544	.645	9.488	9	47	.000
2	.803	.645	.585	.73797	.000	.043	1	49	.837
3	.803	.644	.594	.73067	.000	.036	1	50	.851
4	.801	.642	.599	.72617	-.003	.386	1	51	.537
5	.798	.637	.601	.72394	-.005	.687	1	52	.411
6	.791	.626	.598	.72716	-.010	1.464	1	53	.232

a Predictors: (Constant), USEFUL, PRIVACY1, PRIVACY2, EASEUSE, AWARE, ANXIETY, EXPER, SECURITY, SPACE
b Predictors: (Constant), PRIVACY1, PRIVACY2, EASEUSE, AWARE, ANXIETY, EXPER, SECURITY, SPACE
c Predictors: (Constant), PRIVACY1, PRIVACY2, EASEUSE, ANXIETY, EXPER, SECURITY, SPACE
d Predictors: (Constant), PRIVACY1, PRIVACY2, EASEUSE, ANXIETY, EXPER, SECURITY
e Predictors: (Constant), PRIVACY1, PRIVACY2, ANXIETY, EXPER, SECURITY
f Predictors: (Constant), PRIVACY1, PRIVACY2, ANXIETY, EXPER

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	47.449	9	5.272	9.488	.000
	Residual	26.117	47	.556		
	Total	73.566	56			
2	Regression	47.426	8	5.928	10.886	.000
	Residual	26.141	48	.545		
	Total	73.566	56			
3	Regression	47.406	7	6.772	12.685	.000
	Residual	26.160	49	.534		
	Total	73.566	56			
4	Regression	47.200	6	7.867	14.918	.000
	Residual	26.366	50	.527		
	Total	73.566	56			
5	Regression	46.838	5	9.368	17.874	.000
	Residual	26.728	51	.524		
	Total	73.566	56			

6	Regression	46.071	4	11.518	21.783	.000
	Residual	27.495	52	.529		
	Total	73.566	56			

a Predictors: (Constant), USEFUL, PRIVACY1, PRIVACY2, EASEUSE, AWARE, ANXIETY, EXPER, SECURITY, SPACE
b Predictors: (Constant), PRIVACY1, PRIVACY2, EASEUSE, AWARE, ANXIETY, EXPER, SECURITY, SPACE
c Predictors: (Constant), PRIVACY1, PRIVACY2, EASEUSE, ANXIETY, EXPER, SECURITY, SPACE
d Predictors: (Constant), PRIVACY1, PRIVACY2, EASEUSE, ANXIETY, EXPER, SECURITY
e Predictors: (Constant), PRIVACY1, PRIVACY2, ANXIETY, EXPER, SECURITY
f Predictors: (Constant), PRIVACY1, PRIVACY2, ANXIETY, EXPER
g Dependent Variable: FUTURE

Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance	VIF	Minimum Tolerance
2	USEFUL	.023	.206	.837	.030	.614	1.629	.308
3	USEFUL	.015	.143	.887	.021	.673	1.487	.338
	AWARE	-.019	-.189	.851	-.027	.728	1.373	.316
4	USEFUL	.034	.350	.728	.050	.764	1.308	.360
	AWARE	-.024	-.244	.808	-.035	.734	1.363	.338
	SPACE	.083	.621	.537	.088	.406	2.461	.340
5	USEFUL	.054	.588	.559	.083	.843	1.186	.367
	AWARE	.002	.026	.979	.004	.814	1.229	.352
	SPACE	.100	.762	.450	.107	.420	2.383	.350
	EASEUSE	.073	.829	.411	.116	.919	1.088	.361
6	USEFUL	.049	.532	.597	.074	.845	1.184	.511
	AWARE	-.015	-.164	.871	-.023	.835	1.198	.503
	SPACE	.113	.865	.391	.120	.423	2.364	.423
	EASEUSE	.076	.854	.397	.119	.919	1.088	.502
	SECURITY	.161	1.210	.232	.167	.401	2.492	.367

a Predictors in the Model: (Constant), PRIVACY1, PRIVACY2, EASEUSE, AWARE, ANXIETY, EXPER, SECURITY, SPACE
b Predictors in the Model: (Constant), PRIVACY1, PRIVACY2, EASEUSE, ANXIETY, EXPER, SECURITY, SPACE
c Predictors in the Model: (Constant), PRIVACY1, PRIVACY2, EASEUSE, ANXIETY, EXPER, SECURITY
d Predictors in the Model: (Constant), PRIVACY1, PRIVACY2, ANXIETY, EXPER, SECURITY
e Predictors in the Model: (Constant), PRIVACY1, PRIVACY2, ANXIETY, EXPER
f Dependent Variable: FUTURE

Reliability for specific privacy questions

		Mean	Std Dev	Cases
1.	Q.2	4.1607	1.6925	57.0
2.	Q.4	4.0179	1.7108	57.0
3.	Q.6	4.0714	1.5592	57.0
4.	Q.14	4.4464	1.8283	57.0

N of Cases = 57.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.2	12.5357	16.9442	.6138	.3888	.7298
Q.4	12.6786	16.2584	.6650	.6821	.7030
Q.6	12.6250	16.1659	.7787	.7208	.6525
Q.14	12.2500	18.9182	.3836	.1992	.8480

Reliability Coefficients 4 items

Alpha = **.7896**

Reliability for general privacy questions

		Mean	Std Dev	Cases
1.	Q.18	4.3509	1.7677	57.0
2.	Q.23	4.8772	1.6591	57.0
3.	Q.30	2.7895	2.0506	57.0
4.	Q.33	5.5965	1.7914	57.0
5.	Q.34	3.8772	2.0535	57.0
6.	Q.35	2.8772	2.2996	57.0

N of Cases = 57.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.18	20.0175	28.8390	.2984	.2761	.3973
Q.23	19.4912	44.1830	-.4219	.2471	**.6829**
Q.30	21.5789	21.2838	.6417	.5933	.1581
Q.33	18.7719	30.8578	.1790	.2772	.4566
Q.34	20.4912	23.5758	.4933	.5178	.2649

Q.35	21.4912	24.5758	.3406	.4945	.3595

Reliability Coefficients 6 items

Alpha = .4730

Reliability for Usefulness questions

		Mean	Std Dev	Cases
1.	Q.1	4.3333	2.1575	57.0
2.	Q.3	5.5263	1.5596	57.0
3.	Q.8	6.2281	1.1498	57.0

N of Cases = 57.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.1	11.7544	5.5815	.3071	.1283	.6547
Q.3	10.5614	7.7506	.3667	.2600	.4577
Q.8	9.8596	8.4442	.5389	.3272	.3214

Reliability Coefficients 3 items

Alpha = **.5564**

Reliability for security questions

		Mean	Std Dev	Cases
1.	Q.5	4.6667	1.5849	57.0
2.	Q.19	2.8596	2.0392	57.0
3.	Q.27	3.0526	1.5859	57.0
4.	Q.32	3.2281	2.0703	57.0

N of Cases = 57.0

Item-total Statistics

Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted

Q.5	9.1404	22.4442	.4487	.2079	.7675
Q.19	10.9474	16.6936	.6506	.4459	.6632
Q.27	10.7544	21.5457	.5185	.2789	.7372
Q.32	10.5789	16.1767	.6744	.4675	.6483

Reliability Coefficients 4 items

Alpha = **.7666**

Reliability for anxiety questions

		Mean	Std Dev	Cases
1.	Q.7	5.1923	1.8978	26.0
2.	Q.9	5.2692	1.5635	26.0
3.	Q.11	4.9231	1.5981	26.0

N of Cases = 26.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.7	10.1923	8.2415	.7785	.6062	.7870
Q.9	10.1154	10.4262	.7384	.5480	.8192
Q.11	10.4615	10.2585	.7340	.5406	.8212

Reliability Coefficients 3 items

Alpha = **.8685**

Reliability for space questions

		Mean	Std Dev	Cases
1.	Q.10	4.7544	1.6397	57.0
2.	Q.13	5.2807	1.3984	57.0
3.	Q.26	5.2456	1.6397	57.0

N of Cases = 57.0

Statistics for	Mean	Variance	Std Dev	N of Variables
Scale	15.2807	6.4198	2.5337	3

Item Means	Mean	Minimum	Maximum	Range	Max/Min	Variance
	5.0936	4.7544	5.2807	.5263	1.1107	.0866

Item Variances	Mean	Minimum	Maximum	Range	Max/Min	Variance
	2.4442	1.9555	2.6886	.7331	1.3749	.1791

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.10	10.5263	2.5038	.2365	.5389	-1.7097
Q.13	10.0000	3.2500	.2408	.5724	-1.3090
Q.26	10.0351	7.9987	-.4601	.2241	**.8388**

Reliability Coefficients 3 items

Alpha = -.2133

Reliability for ease of use questions

		Mean	Std Dev	Cases
1.	Q.20	6.2105	1.6228	57.0
2.	Q.12	6.0877	1.3401	57.0

N of Cases = 57.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.20	6.0877	1.7957	.5826	.3394	.
Q.12	6.2105	2.6335	.5826	.3394	.

Reliability Coefficients 2 items

Alpha = **.7278**

Reliability for awareness questions

		Mean	Std Dev	Case
1.	Q.15	4.7143	2.2835	21.0
2.	Q.16	4.8095	1.9136	21.0
3.	Q.17	4.0476	2.2243	21.0

N of Cases = 21.0

Item-total Statistics

Scale Scale Corrected

	Mean if Item Deleted	Variance if Item Deleted	Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.15	8.8571	14.0286	.6614	.5508	.7726
Q.16	8.7619	14.9905	.8034	.6548	.6442
Q.17	9.5238	15.3619	.5877	.4052	.8444

Reliability Coefficients 3 items

Alpha = **.8214**

Reliability for experience questions

		Mean	Std Dev	Cases
1.	Q.21	2.7544	1.6827	57.0
2.	Q.28	4.8246	1.6049	57.0
3.	Q.29	5.2281	1.4395	57.0
4.	Q.31	5.0000	1.4516	57.0

N of Cases = 57.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.21	15.0526	16.8365	.3407	.1994	.8982
Q.28	12.9825	13.7675	.6742	.5679	.7362
Q.29	12.5789	14.4267	.7201	.7045	.7187
Q.31	12.8070	13.3014	.8466	.7791	.6566

Reliability Coefficients 4 items

Alpha = **.8089**

Reliability for future use questions

		Mean	Std Dev	Cases
1.	Q.22A	3.2982	1.7624	57.0
2.	Q.22B	4.4912	1.8334	57.0
3.	Q.22C	3.1053	1.7797	57.0
4.	Q.22D	3.9649	1.7624	57.0
5.	Q.22E	5.7544	1.3794	57.0
6.	Q.24	3.3684	1.7991	57.0
7.	Q.25	5.5439	1.3103	57.0
8.	Q.36	4.2982	2.4199	57.0

N of Cases = 57.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
Q.22A	30.5263	62.3609	.6686	.7538	.7486
Q.22B	29.3333	59.5119	.7495	.7152	.7336
Q.22C	30.7193	62.9198	.6371	.7555	.7534
Q.22D	29.8596	63.0871	.6388	.5734	.7534
Q.22E	28.0702	70.6021	.4991	.4698	.7775
Q.24	30.4561	69.0025	.3960	.2332	.7910
Q.25	28.2807	77.2412	.2222	.2427	.8082
Q.36	29.5263	65.1823	.3337	.2316	.8159

Reliability Coefficients 8 items

Alpha = **.7969**

APPENDIX B

QUESTIONNAIRE, RELIABILITY ANALYSE AND PRINCIPLE COMPONENTS ANALYSIS OUTPUT FOR THE STUDY REPORTED IN CHAPTER 6.

Questionnaire

I am carrying out research with regard to automated teller machine use (ATM). I am interested in your opinions, views, feelings and experiences related to ATM use.

Would you please read and respond to ***all*** the following statements using a rating scale from 1 to 7 of how strongly you agree or disagree with each statement. Please circle which number applies to your view/experience e.g.

SD 1	2	3	4	5	6	7 SA
strongly disagree	disagree somewhat	disagree slightly	neither agree nor disagree	agree slightly	agree somewhat	strongly agree

---

When someone is using an ATM I believe other people stand well back.	SD 1 2 3 4 5 6 7 SA
When there is a queue you have to hurry when using an ATM.	SD 1 2 3 4 5 6 7 SA
Other people can see what I'm doing when I am using an ATM.	SD 1 2 3 4 5 6 7 SA
I would like to use ATM's to do other transactions not related to my bank account (e.g. purchase tickets).	SD 1 2 3 4 5 6 7 SA
When I am using an ATM I feel people waiting to use it don't give me enough space	SD 1 2 3 4 5 6 7 SA
I feel under pressure when there is a queue at an ATM.	SD 1 2 3 4 5 6 7 SA
I believe ATM's should only be used for banking purposes.	SD 1 2 3 4 5 6 7 SA
I feel as if other people watch me when I use an ATM.	SD 1 2 3 4 5 6 7 SA
I feel at risk if I spend too much time using an ATM.	SD 1 2 3 4 5 6 7 SA
I feel I have to stand too close to the user when I am waiting to use an ATM.	SD 1 2 3 4 5 6 7 SA
I believe you have to use an ATM quickly in certain locations e.g. railway stations.	SD 1 2 3 4 5 6 7 SA
I believe more functions on an ATM would be helpful.	SD 1 2 3 4 5 6 7 SA
Learning how to use an ATM is difficult for me.	SD 1 2 3 4 5 6 7 SA
I feel vulnerable when using an ATM.	SD 1 2 3 4 5 6 7 SA

ATM's do not offer all the financial services I would like them to.	SD 1 2 3 4 5 6 7 SA
I am only interested in using ATM's for cash withdrawal.	SD 1 2 3 4 5 6 7 SA
When I use an ATM other people's behaviour nearby makes me nervous.	SD 1 2 3 4 5 6 7 SA
I think ATM's are a simple way of accessing cash.	SD 1 2 3 4 5 6 7 SA
I find using an ATM frustrating.	SD 1 2 3 4 5 6 7 SA
It does not bother me using an ATM when there is no one else around.	SD 1 2 3 4 5 6 7 SA
I feel uncomfortable using an ATM when there is someone queuing behind me.	SD 1 2 3 4 5 6 7 SA
When I use an ATM the only time I feel I have enough privacy is when no one else is around.	SD 1 2 3 4 5 6 7 SA
I find I can do all the financial things I need to do on an ATM.	SD 1 2 3 4 5 6 7 SA
I believe people should take as long as they like when they use an ATM.	SD 1 2 3 4 5 6 7 SA
When I use an ATM I am concerned other people can see personal information (e.g. my account balance).	SD 1 2 3 4 5 6 7 SA
When I am waiting to use an ATM I deliberately avoid contact with the user	SD 1 2 3 4 5 6 7 SA
I feel comfortable with the design of ATM's.	SD 1 2 3 4 5 6 7 SA
I believe there is generally enough space around me when I use an ATM.	SD 1 2 3 4 5 6 7 SA
I would feel uncomfortable if a close family member or friend saw my personal financial information on an ATM screen.	SD 1 2 3 4 5 6 7 SA
I do not like anyone to speak to me when I am using an ATM.	SD 1 2 3 4 5 6 7 SA
I assess the area to make sure it is safe when approaching an ATM.	SD 1 2 3 4 5 6 7 SA
I do not like being observed by others when I use an ATM.	SD 1 2 3 4 5 6 7 SA
I believe there is a high risk of being robbed	SD 1 2 3 4 5 6 7 SA

when using an ATM.

I find ATM's are easy to use.	SD 1 2 3 4 5 6 7 SA
When I use an ATM I feel there is enough space behind me for people to pass by.	SD 1 2 3 4 5 6 7 SA
I feel you can only undertake one transaction on an ATM if there is a queue	SD 1 2 3 4 5 6 7 SA
When I use an ATM I find the instructions clear and understandable.	SD 1 2 3 4 5 6 7 SA
I feel I have to spend less time using an ATM if other people are waiting.	SD 1 2 3 4 5 6 7 SA
I avoid looking directly at the ATM user.	SD 1 2 3 4 5 6 7 SA
All things considered, I find using ATM's a negative experience.	SD 1 2 3 4 5 6 7 SA
All things considered, I find using ATM's a frustrating experience.	SD 1 2 3 4 5 6 7 SA
All things considered, I find using ATM's a good experience.	SD 1 2 3 4 5 6 7 SA

I intend to use an ATM in the next week to:

a) Withdraw cash from my account	SD 1 2 3 4 5 6 7 SA
b) check my account balance	SD 1 2 3 4 5 6 7 SA
c) deposit money into an account	SD 1 2 3 4 5 6 7 SA

Please look at the list of places in the left column below that you might have used an ATM. When you use ATM's in these places could you indicate (on a scale from 1 to 7)) below whether you felt you had enough/not enough privacy, personal space etc. For example if you have used an ATM in a railway station, you may have thought you did not have enough personal space and privacy due to other people waiting to use the ATM. Or you may have experienced difficulty using the ATM and also had concern over you safety. Therefore your responses would look something like this:

Not sufficient 1 2 3 4 5 6 7
sufficient

	Personal space	**Privacy**	**Time**	**Ease of use**	**Safety**	**Services on ATM**
Railway station	2	2	2	6	3	6

	Personal space	**Privacy**	**Time**	**Ease of use**	**Safety**	**Services on ATM**
Railway station						
Local store						
Bank foyer						
Supermarket						
Garage						
Local high street						
Leisure centre						
Department store						
City centre street						

SEX: **Female** **Male**

AGE: ....

On average how many times do you use an ATM per week?
1 2 3 4 5 6 7+

Please state the location of the ATM you use most often.
....

How would you rate the ATM you use most often for privacy?
(from 1-7 with 1 being not at all private to 7 being very private)
not at all 1 2 3 4 5 6 7 very private
private

Thinking about the ATM you use most frequent; how many people are usually in the area the ATM is located?
0 1-3 4-6 7-9 10-12 13-15 16-18+

How often is there a queue behind you when you use an ATM?
(1 being ***never*** to 7 being ***always***)
never a queue 1 2 3 4 5 6 7 always a queue

What time of day are you most likely to use an ATM?
(morning) (afternoon) (evening)
1-6am 7-9am 10-12am 1-3pm 4-6pm 7-9pm 10-12pm

Thank you for your time and co-operation. Please post the completed questionnaire back to Northumbria University in the pre-paid envelope provided.

Principle Components Analysis chapter 6

Communalities

	Raw	Rescaled
	Initial	Initial
SP1	3.206	1.000
SP2	3.255	1.000
SP3	3.130	1.000
SP4	3.045	1.000
SP5	2.901	1.000
SP6	2.647	1.000
TIM1	2.944	1.000
TIM2	3.373	1.000
TIM3	2.970	1.000
TIM4	4.053	1.000
TIM5	3.869	1.000
TIM6	3.353	1.000
PRIV1	3.030	1.000
PRIV2	2.293	1.000
PRIV3	3.357	1.000
PRIV4	3.150	1.000
PRIV5	4.083	1.000
PRIV6	2.260	1.000
FUNCT1	4.286	1.000
FUNCT2	4.141	1.000
FUNCT3	3.122	1.000
FUNCT4	3.138	1.000
FUNCT5	4.654	1.000
SAF1	3.021	1.000
SAF2	3.321	1.000
SAF3	2.913	1.000
SAF4	3.308	1.000
SAF5	2.685	1.000
SAF6	2.748	1.000
EASE1	2.799	1.000
EASE2	1.753	1.000
EASE3	3.081	1.000
EASE4	2.427	1.000
EASE5	1.493	1.000
EASE6	1.983	1.000
SI1	2.126	1.000
SI3	2.470	1.000

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Component	Initial Eigenvalues [a]			Rotation Sums of Squared Loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Raw	1	28.237	25.125	25.125	20.885	18.583	18.583
	2	12.080	10.749	35.874	11.756	10.460	29.043
	3	6.166	5.487	41.360	6.972	6.203	35.246
	4	5.803	5.164	46.524	9.386	8.351	43.597
	5	5.477	4.873	51.397	6.108	5.435	49.032
	6	4.440	3.951	55.348	5.182	4.611	53.643
	7	3.719	3.309	58.657	4.789	4.261	57.904
	8	3.411	3.035	61.692	3.918	3.486	61.390
	9	3.070	2.732	64.424	3.410	3.034	64.424
	10	2.642	2.351	66.775			
	11	2.503	2.228	69.003			
	12	2.475	2.202	71.205			
	13	2.314	2.059	73.264			
	14	2.171	1.932	75.195			
	15	2.047	1.821	77.016			
	16	1.968	1.751	78.768			
	17	1.911	1.700	80.468			
	18	1.711	1.522	81.990			
	19	1.667	1.484	83.474			
	20	1.574	1.400	84.874			
	21	1.493	1.329	86.203			
	22	1.448	1.288	87.491			
	23	1.346	1.197	88.689			
	24	1.292	1.150	89.838			
	25	1.201	1.069	90.907			
	26	1.177	1.047	91.954			
	27	1.135	1.010	92.963			
	28	1.082	.963	93.926			
	29	.992	.883	94.809			
	30	.939	.836	95.645			
	31	.874	.777	96.422			
	32	.809	.720	97.142			
	33	.754	.671	97.813			
	34	.717	.638	98.452			
	35	.669	.595	99.046			
	36	.620	.552	99.598			
	37	.452	.402	100.000			
Rescaled	1	28.237	25.125	25.125	7.072	19.114	19.114
	2	12.080	10.749	35.874	3.095	8.364	27.478
	3	6.166	5.487	41.360	2.857	7.720	35.198
	4	5.803	5.164	46.524	2.821	7.625	42.823
	5	5.477	4.873	51.397	1.963	5.305	48.128
	6	4.440	3.951	55.348	1.747	4.720	52.848
	7	3.719	3.309	58.657	1.300	3.514	56.363
	8	3.411	3.035	61.692	1.245	3.364	59.727
	9	3.070	2.732	64.424	.954	2.579	62.306
	10	2.642	2.351	66.775			
	11	2.503	2.228	69.003			
	12	2.475	2.202	71.205			
	13	2.314	2.059	73.264			
	14	2.171	1.932	75.195			
	15	2.047	1.821	77.016			
	16	1.968	1.751	78.768			
	17	1.911	1.700	80.468			
	18	1.711	1.522	81.990			
	19	1.667	1.484	83.474			
	20	1.574	1.400	84.874			
	21	1.493	1.329	86.203			
	22	1.448	1.288	87.491			
	23	1.346	1.197	88.689			
	24	1.292	1.150	89.838			
	25	1.201	1.069	90.907			
	26	1.177	1.047	91.954			
	27	1.135	1.010	92.963			
	28	1.082	.963	93.926			
	29	.992	.883	94.809			
	30	.939	.836	95.645			
	31	.874	.777	96.422			
	32	.809	.720	97.142			
	33	.754	.671	97.813			
	34	.717	.638	98.452			
	35	.669	.595	99.046			
	36	.620	.552	99.598			
	37	.452	.402	100.000			

Extraction Method: Principal Component Analysis.

a. When analyzing a covariance matrix, the initial eigenvalues are the same across the raw and rescaled solution.

Component Matrix[a]

a. 9 components extracted.

Rotated Component Matrix[a]

	Raw									Rescaled								
	Component									Component								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
SP1						1.280									.715			
SP2	1.232									.683								
SP3				.790									.447					
SP4	1.187									.680								
SP5	.826					.915				.485					.537			
SP6						.965									.593			
TIM1				1.102									.642					
TIM2	1.113			.957						.606			.521					
TIM3	.943			.756						.547			.439					
TIM4							1.794									.891		
TIM5				1.512									.769					
TIM6				1.429									.780					
PRIV1	.964									.554								
PRIV2	1.082									.714								
PRIV3	1.309									.714								
PRIV4	1.154									.650								
PRIV5					1.575									.779				
PRIV6	.969				.652					.644				.434				
FUNCT1		1.768									.854							
FUNCT2		1.683									.827							
FUNCT3		1.423									.805							
FUNCT4		1.281									.723							
FUNCT5		1.305							-1.151		.605							-.534
SAF1	1.341									.772								
SAF2	1.151									.632								
SAF3	1.298									.761								
SAF4								1.589									.874	
SAF5	.906				.737					.553				.450				
SAF6	1.093									.659								
EASE1			.937									.560						
EASE2			.721									.545						
EASE3			1.258									.717						
EASE4			.895									.574						
EASE5			.869									.711						
EASE6			.858									.609						
SI1					.713									.489				
SI3					.808									.514				

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 16 iterations.

Component Transformation Matrix

Component	1	2	3	4	5	6	7	8	9
1	.828	-.083	.224	.423	.221	.144	.043	.081	.018
2	.054	.965	.036	.050	.122	-.109	-.107	.029	-.152
3	.182	-.099	.446	-.635	.245	-.101	-.527	-.073	-.042
4	-.307	.002	.852	.205	-.122	-.092	.326	.057	-.074
5	.196	.192	.104	-.351	-.547	.660	.159	-.066	.160
6	-.183	.028	-.026	-.230	.717	.435	.404	.208	.045
7	.037	.005	-.017	-.100	-.175	-.145	-.082	.941	.209
8	-.310	-.051	.066	.400	.038	.549	-.615	.137	-.192
9	-.121	.109	.091	.165	.124	-.021	-.172	-.177	.928

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Reliability analysis for Space questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
SP1	20.0945	34.9290	.2394	.7140
SP2	21.5765	30.7155	.4617	.6425
SP3	20.5342	32.4457	.3784	.6701
SP4	21.3290	30.8620	.4795	.6368
SP5	20.8371	29.5943	.5778	.6045
SP6	20.5309	32.4459	.4375	.6514

Reliability Coefficients

N of Cases = 307.0　　　　N of Items = 6

Alpha = **.6949**

Reliability analysis for Time questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
TIM1	18.3746	43.8167	.6492	.7474
TIM2	18.4104	42.2951	.6631	.7420
TIM3	18.1759	45.8252	.5448	.7701
TIM4	17.1336	50.2991	.2506	.8397
TIM5	17.9902	42.9640	.5690	.7644
TIM6	18.3029	41.3883	.7116	.7303

Reliability Coefficients

N of Cases = 307.0　　　　N of Items = 6

Alpha = **.7988**

Reliability analysis for Privacy questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
PRIV1	16.2020	36.8806	.5269	.7367
PRIV2	16.2736	38.3105	.5573	.7318
PRIV3	16.1368	35.0335	.5837	.7214
PRIV4	16.5537	34.4440	.6459	.7048
PRIV5	15.7915	40.7995	.2389	.8183

PRIV6	16.8762	36.9062	.6506	.7110

Reliability Coefficients

N of Cases = 307.0 N of Items = 6

Alpha = **.7728**

Reliability analysis for Usefulness questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
USE1	19.1954	29.6741	.6506	.4370
USE2	19.2410	30.7848	.6070	.4604
USE3	18.9870	32.1044	.6696	.4532
USE4	19.5993	34.8488	.5090	.5165
USE5	19.6547	33.2856	.4296	.5390
USE6	18.6319	57.4229	-.4174	**.8290**

Reliability Coefficients

N of Cases = 307.0 N of Items = 6

Alpha = .6180

Reliability analysis for Safety questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
SAF1	18.4625	36.2167	.6950	.7331
SAF2	18.3844	36.9890	.6075	.7541
SAF3	18.2541	36.7130	.6840	.7365
SAF5	19.1205	39.9952	.5353	.7715
SAF6	19.0358	38.7863	.5928	.7586
SAF4	17.0033	44.3954	.2505	.8365

Reliability Coefficients

N of Cases = 307.0 N of Items = 6

Alpha = **.7984**

Reliability for Ease of Use questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
EASE1	28.3355	25.5701	.3407	.7252
EASE2	28.0521	26.8796	.4008	.7021
EASE3	28.7394	22.1083	.5420	.6589
EASE4	29.3681	25.0373	.4279	.6954
EASE5	28.2378	24.7831	.6458	.6426
EASE6	28.5049	25.6952	.4523	.6880

Reliability Coefficients

N of Cases = 307.0 N of Items = 6

Alpha = **.7242**

Reliability for Social Interaction questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
SI1	6.1433	7.3323	.4311	.4047
SI2	5.7590	6.7979	.2802	**.6479**
SI3	5.6156	6.7080	.4528	.3586

Reliability Coefficients

N of Cases = 307.0 N of Items = 3

Alpha = .5700

Reliability for Attitude questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
ATT1	10.2117	6.6119	.7820	.5733
ATT2	10.0293	7.1658	.6897	.6836
ATT3	10.4625	10.0076	.5013	.8649

Reliability Coefficients

N of Cases = 307.0 N of Items = 3

Alpha = **.8016**

Reliability for Intention questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
INT1	6.5733	8.9121	.4210	.2368
INT2	7.5961	6.3919	.5138	.0013
INT3	10.2280	14.4054	.0897	**.6945**

Reliability Coefficients

N of Cases = 307.0 N of Items = 3

Alpha = .5083

Structural Equation Modelling Output

```
  EQS, A STRUCTURAL EQUATION PROGRAM          MULTIVARIATE SOFTWARE, INC.
 COPYRIGHT BY P.M. BENTLER                VERSION 5.7b (C) 1985 - 1998.


 PROGRAM CONTROL INFORMATION

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 /SPECIFICATIONS
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  VARIABLES= 8; CASES= 307;
  METHODS=ML;
  MATRIX=RAW;
 /LABELS
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  V6=EASE; V7=ATT; V8=INT;
 /EQUATIONS
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  V8 =  + *V2 + *V5 + *V6 + *V7 + 1E8;
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  V3 = *;
  V4 = *;
  V5 = *;
  V6 = *;
  E7 = *;
  E8 = *;
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  V3 , V1 = *;
  V3 , V2 = *;
  V4 , V1 = *;
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   SET=PVV,PFV,PFF,PDD,GVV,GVF,GFV,GFF,BVF,BFF;
 /WTEST
   PVAL=0.05;
   PRIORITY=ZERO;
 /PRINT
   digit=3;
   linesize =80;
   RETEST='Retest.eqs';
   fit=all;
 /OUTPUT
    Parameter estimates;
    standard errors;
```

```
53   listing;
54   data='EQSOUT&.ETS';
55  /end
```

55 RECORDS OF INPUT MODEL FILE WERE READ

DATA IS READ FROM A:\LINDAL47.ESS
THERE ARE 8 VARIABLES AND 307 CASES
IT IS A RAW DATA ESS FILE

SAMPLE STATISTICS BASED ON COMPLETE CASES

UNIVARIATE STATISTICS

VARIABLE	TIME	SPACE	PRIVACY	SAFETY	FUNCT
MEAN	3.6129	4.1634	3.2611	3.6754	3.7264
SKEWNESS (G1)	0.5389	-0.1301	0.4347	0.3095	0.1283
KURTOSIS (G2)	-0.0412	-0.3766	-0.1809	-0.2705	-0.6610
STANDARD DEV.	1.3071	1.0955	1.1908	1.2222	1.5156

VARIABLE	EASE	ATT	INT
MEAN	5.7079	5.1173	5.1140
SKEWNESS (G1)	-1.2605	-0.5770	-0.8407
KURTOSIS (G2)	2.3178	-0.0984	-0.2842
STANDARD DEV.	0.9737	1.3428	1.8977

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 7.1880
NORMALIZED ESTIMATE = 4.9784

ELLIPTICAL THEORY KURTOSIS ESTIMATES

```
 MARDIA-BASED KAPPA =      0.0899 MEAN SCALED UNIVARIATE KURTOSIS =    0.0169

 MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA=        0.0899


 CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE
KURTOSIS:
 ---------------------------------------------------------------------------

 CASE NUMBER       6        26        38       153       233

 ESTIMATE     573.6424  647.3307  510.7768  323.0482  539.9703


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 EQS/EM386 Licensee: Division of Psychology
 COVARIANCE  MATRIX TO BE ANALYZED:  8 VARIABLES (SELECTED FROM  8
VARIABLES)
 BASED ON   307 CASES.


              TIME    SPACE    PRIVACY   SAFETY    FUNCT
              V 1      V 2      V 3       V 4       V 5
  TIME  V 1    1.709
 SPACE  V 2    0.764    1.200
 PRIVACY V 3   0.861    0.895    1.418
 SAFETY  V 4   0.853    0.798    1.062    1.494
 FUNCT   V 5  -0.142   -0.201   -0.057    0.020    2.297
  EASE  V 6    0.244    0.315    0.316    0.341   -0.036
  ATT   V 7    0.475    0.657    0.721    0.683    0.178
  INT   V 8    0.047   -0.158    0.002    0.098    0.571


              EASE     ATT      INT
              V 6      V 7      V 8
  EASE  V 6    0.948
  ATT   V 7    0.808    1.803
  INT   V 8    0.585    0.727    3.601


 BENTLER-WEEKS STRUCTURAL REPRESENTATION:

    NUMBER OF DEPENDENT VARIABLES = 2
      DEPENDENT V'S :   7   8

    NUMBER OF INDEPENDENT VARIABLES = 8
      INDEPENDENT V'S :   1   2   3   4   5   6
      INDEPENDENT E'S :   7   8

    NUMBER OF FREE PARAMETERS = 33
    NUMBER OF FIXED NONZERO PARAMETERS =  2


 3RD STAGE OF COMPUTATION REQUIRED      3488 WORDS OF MEMORY.
 PROGRAM ALLOCATED   5000000 WORDS

 DETERMINANT OF INPUT MATRIX IS  0.32175E+01
```

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MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 902.456 ON 28 DEGREES OF FREEDOM

INDEPENDENCE AIC = 846.45551 INDEPENDENCE CAIC = 714.10377
MODEL AIC = -4.65517 MODEL CAIC = -18.83571

CHI-SQUARE = 1.345 BASED ON 3 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.71852
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 1.342.

```
BENTLER-BONETT NORMED    FIT INDEX=   0.999
BENTLER-BONETT NONNORMED FIT INDEX=   1.018
COMPARATIVE FIT INDEX (CFI)  =  1.000
BOLLEN (IFI)        FIT INDEX=   1.002
McDonald (MFI)      FIT INDEX=   1.003
LISREL GFI          FIT INDEX=   0.999
LISREL AGFI         FIT INDEX=   0.987
ROOT MEAN SQUARED RESIDUAL (RMR) =   0.019
STANDARDIZED RMR            =   0.008
ROOT MEAN SQ. ERROR OF APP.(RMSEA)=   0.000
90% CONFIDENCE INTERVAL OF RMSEA (   0.000,   0.070)
```

```
ATT =V7 = -.042*V1  + .221*V2  + .195*V3  + .061*V4
           .053       .073       .076       .068
          -.791      3.046      2.568       .899

        + .110*V5  + .706*V6  + 1.000 E7
           .036       .059
          3.011     11.958

INT =V8 =  .306*V7  - .396*V2  + .198*V5  + .496*V6
           .100       .101       .066       .128
          3.042     -3.911      2.998      3.871

        + 1.000 E8
```

STANDARDIZED SOLUTION: R-SQUARED

```
ATT =V7 = -.041*V1  + .180*V2  + .173*V3  + .056*V4
        + .124*V5  + .512*V6  + .708 E7              .498
INT =V8 =  .216*V7  - .229*V2  + .158*V5  + .254*V6
        + .899 E8                           .191
```

CORRELATIONS AMONG INDEPENDENT VARIABLES

```
         V                F
        ---              ---
V2 -SPACE       .534*I              I
V1 - TIME          I             I
             I             I
V3 -PRIVACY      .553*I              I
V1 - TIME          I             I
             I             I
V4 -SAFETY       .534*I             I
V1 - TIME          I             I
             I             I
V5 -FUNCT       -.072*I             I
V1 - TIME          I             I
             I             I
V6 - EASE       .192*I            I
V1 - TIME          I             I
             I             I
V3 -PRIVACY      .686*I              I
V2 -SPACE           I             I
             I             I
V4 -SAFETY       .596*I             I
V2 -SPACE           I             I
             I             I
V5 -FUNCT       -.121*I             I
V2 -SPACE           I             I
             I             I
V6 - EASE       .295*I            I
V2 -SPACE           I             I
             I             I
V4 -SAFETY       .729*I             I
V3 -PRIVACY          I             I
             I             I
V5 -FUNCT       -.032*I             I
V3 -PRIVACY          I             I
             I             I
V6 - EASE       .272*I            I
V3 -PRIVACY          I             I
             I             I
V5 -FUNCT        .011*I             I
V4 -SAFETY          I             I
             I             I
V6 - EASE       .286*I            I
V4 -SAFETY          I             I
             I             I
V6 - EASE      -.024*I            I
V5 -FUNCT           I             I
             I             I
```

END OF METHOD

WALD TEST (FOR DROPPING PARAMETERS)
MULTIVARIATE WALD TEST BY SIMULTANEOUS PROCESS

CUMULATIVE MULTIVARIATE STATISTICS					UNIVARIATE INCREMENT	
STEP	PARAMETER	CHI-SQUARE	D.F.	PROBABILITY	CHI-SQUARE	PROBABILITY
1	V5,V4	0.037	1	0.848	0.037	0.848
2	V6,V5	0.286	2	0.867	0.249	0.618
3	V7,V1	0.911	3	0.823	0.626	0.429

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EQS/EM386 Licensee: Division of Psychology
MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

LAGRANGIAN MULTIPLIER TEST REQUIRES 3278 WORDS OF MEMORY.
PROGRAM ALLOCATES 5000000 WORDS.

LAGRANGE MULTIPLIER TEST (FOR ADDING PARAMETERS)

ORDERED UNIVARIATE TEST STATISTICS:

NO	CODE		PARAMETER	CHI-SQUARE	PROBABILITY	PARAMETER CHANGE
1	2	11	V8,V1	1.072	0.301	0.092
2	2	11	V8,V4	0.116	0.733	0.035
3	2	11	V8,V3	0.013	0.909	-0.013

***** NONE OF THE UNIVARIATE LAGRANGE MULTIPLIERS IS SIGNIFICANT,
***** THE MULTIVARIATE TEST PROCEDURE WILL NOT BE EXECUTED.
1
Execution begins at 10:34:30.61
Execution ends at 10:34:41.71
Elapsed time = 11.10 seconds

APPENDIX C

INTERNET, QUESTIONNAIRE, RELIABILITY ANALYSE, PRINCIPLE COMPONENTS ANALYSIS ANS STRUCTURAL EQUATION MODELLING OUTPUT FOR THE STUDIES REPORTED IN CHAPTER 7.

Example of Internet survey reported in chapter 7

Technology use in the Public Arena

I am carrying out research with regard to different technologies used in public areas. I am interested in your opinions, views, feelings, experiences related to the use of mobile telephones, computers used in Internet Cafes, public information kiosks and automated teller machines (ATMs). As well as trying to build up an overall picture of technology use within public areas I am also interested in how people's individual differences affect perceptions and experiences.

I would be grateful if you could spare around 10 minutes of your time and complete *one* of the following questionnaires related to each of the different technologies mentioned above. You can exit the survey at any time.

The study is confidential therefore individual responses cannot be identified in any way. As a result no individual feedback can be given. A summary of the results will be available from August 2003 and can be obtained by e-mail from: l.little@unn.ac.uk

Thank you for your co-operation, it is greatly appreciated.

To take part in the research you will need to agree the consent form found at the end of the document

---

Select a questionnaire to fill in:

- ○ Automated Teller Machines (ATMs)
- ○ Internet Cafe
- ○ Mobile Phones
- ○ Public Information Kiosks

Click [I agree] if you have read the consent form and accept its terms.

It will take no more than ten minutes to fill it in.

Consent Form

This study involves a web-based experiment designed to try to develop understanding of what factors influence the users of technologies in public areas. Linda Little a postgraduate student at Northumbria University, UK is conducting the study.

The Division of Psychology, Northumbria University Ethics Board, has approved the research. No deception is involved, and the study involves no more than minimal risk to participants (i.e., the level of risk encountered in daily life).

Participation in the study typically takes 10 minutes and is strictly anonymous. All responses are treated as confidential, and in no case will responses from individual participants be identified. If participants have further questions about this study or their rights, or if they wish to lodge a complaint or concern, they may contact the principal investigator by e-mail:l.little@unn.ac.uk.

If you are 16 years of age or older, understand the statements above, and freely consent to participate in the study, click on the

"I Agree" button to begin the experiment.

Section 1

1	Sex.	male	female					
2	Age.	16-25	26-35	36-45	46-55	56-65	65+	

Click here to submit your evaluation.

Section 2

Would you please read and respond to all the following statements using a rating scale from 1 to 7 of how strongly you agree or disagree with each statement. Please click on the number which applies to your view/experience e.g.

1	2	3	4	5	6	7
Strongly Agree	Agree Somewhat	Agree Slightly	neither agree or disagree	Disagree Slightly	Disagree Somewhat	Strongly Disagree

1	In a crowded place you have to hurry when using a mobile telephone.	1	2	3	4	5	6	7
2	Other people can hear my conversation when I am using a mobile telephone.	1	2	3	4	5	6	7
3	I would like to use a mobile telephone to do other activities e.g. get instant access to my bank account.	1	2	3	4	5	6	7
4	When I am using a mobile telephone I feel other people don't give me enough space	1	2	3	4	5	6	7
5	I believe mobile phones should only be used for emergencies.	1	2	3	4	5	6	7
6	I feel as if other people listen to me when I use a mobile telephone.	1	2	3	4	5	6	7
7	I feel at risk if I spend too much time using a mobile telephone.	1	2	3	4	5	6	7
8	I believe more functions on a mobile telephone would be helpful.	1	2	3	4	5	6	7
9	Learning how to use a mobile telephone is difficult for me.	1	2	3	4	5	6	7
10	I feel vulnerable when using a mobile telephone.	1	2	3	4	5	6	7
11	When I use a mobile telephone other people's behaviour nearby makes me nervous.	1	2	3	4	5	6	7
12	I find using a mobile telephone frustrating.	1	2	3	4	5	6	7

		○	○	○	○	○	○	○
13	I feel uncomfortable using a mobile telephone in a crowded place.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
14	When I use a mobile telephone the only time I feel I have enough privacy is when no one else is around.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
15	When I use a mobile telephone I deliberately avoid contact with other people.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
16	I believe there is generally enough space around me when I use a mobile telephone.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
17	I find mobile phones are easy to use.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
18	In a crowd I feel you cannot undertake more than one activity on a mobile telephone.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
19	I feel I have to talk less on a mobile telephone when other people are around.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
20	When someone is using a mobile telephone I avoid looking directly at them.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
21	All things considered, I find mobile telephones an effective public resource.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
22	All things considered, I find mobile telephones provide a poor service.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
23	I intend to use a mobile telephone in the next week to: Telephone a friend/colleague.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○
24	I intend to use a mobile telephone in the next week to: Access stored information.	1 ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 ○

Click here to submit your evaluation.

Section 3

1	I am a fairly adventurous person	True ○	False ○
2	I do not like change in my usual routine.	True ○	False ○
3	I easily become involved in other peoples problems.	True ○	False ○
4	When people make mistakes I find it easy to sympathize with them.	True ○	False ○
5	People should deal with their own troubles and not seek help from others.	True ○	False ○
6	I do not like being the centre of attention.	True	False

7	I feel uncomfortable in crowded situations.	True	False
8	I frequently worry over trivial things.	True	False
9	I am a relaxed, easy-going person.	True	False
10	I value other people's opinions.	True	False
11	It takes people a long time to get to know me.	True	False
12	I enjoy new challenges and experiences	True	False
13	I easily get irritated.	True	False
14	I am a very patient person.	True	False
15	It would not bother me if I had to wait in a queue.	True	False
16	I prefer to be alone.	True	False
17	If I have a problem I find it easy to confide in my friends.	True	False
18	I find it easy to talk to strangers.	True	False
19	I always feel self-conscious when I meet new people.	True	False
20	I enjoy co-operating with others.	True	False
21	I would not take advantage of someone to benefit my own needs.	True	False
22	I prefer to work as part of a team.	True	False
23	I am good at organizing other people.	True	False
24	I would rather lead a group than follow it.	True	False
25	When paying for something I would rather use a machine than interact with another human.	True	False
26	I enjoy new challenges and experiences	True	False

27	I believe I am a sociable person.	True	False
28	Other people can always tell when I am sad.	True	False

Click here to submit your evaluation.

Section 4 - Final Few Questions

1	Country of Residence	
2	Educational Qualifications	choose

Click here to submit your evaluation.

Thanks for taking the trouble to complete this questionnaire

Reliability for time questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
TIM1	7.0619	12.2543	.5023	.8213
TIM5	6.6775	9.5787	.6394	.6853
TIM6	6.9902	9.5653	.7341	.5755

Reliability Coefficients

N of Cases = 307.0 N of Items = 3

Alpha = **.7818**

Reliability for usefulness questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
USE1	7.8958	11.3355	.6970	.7186
USE2	7.9414	11.8462	.6676	.7493
USE3	7.6873	13.7058	.6506	.7703

Reliability Coefficients

N of Cases = 307.0   N of Items = 3

Alpha = **.8163**

Reliability for ease of use questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
EASE1	11.5179	6.3093	.4354	.5500
EASE3	11.9218	5.6409	.4854	.4780
EASE5	11.4202	8.1921	.4408	.5644

Reliability Coefficients

N of Cases = 307.0   N of Items = 3

Alpha = **.6338**

Reliability for social interaction questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
SI1	3.0000	3.3791	.2243	.
SI2	2.6156	2.1263	.2243	.

Reliability Coefficients

N of Cases = 307.0 N of Items = 2

Alpha = **.3586**

Reliability for attitude questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
ATT1	5.3225	2.8401	.7619	.
ATT2	5.1401	2.8398	.7619	.

Reliability Coefficients

N of Cases = 307.0 N of Items = 2

Alpha = **.8649**

Reliability for intention questions

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
INT1	4.6026	5.4363	.5385	.
INT2	5.6254	3.9671	.5385	.

Reliability Coefficients

N of Cases = 307.0 N of Items = 2

Alpha = **.6945**

Principle Components Analysis 24-item questionnaire

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
SP2	3.4039	1.80406	307
SP4	3.6515	1.74493	307
SP5	4.1433	1.70322	307
TIM1	3.3029	1.71577	307
TIM5	3.6873	1.96703	307
TIM6	3.3746	1.83103	307
PRIV1	3.3648	1.74065	307
PRIV2	3.2932	1.51422	307
PRIV3	3.4300	1.83221	307
FUNCT1	3.8664	2.07027	307
FUNCT2	3.8208	2.03495	307
FUNCT3	4.0749	1.76687	307
SAF1	3.5896	1.73797	307
SAF2	3.6678	1.82226	307
SAF3	3.7980	1.70685	307
EASE1	5.9121	1.67315	307
EASE3	5.5081	1.75523	307
EASE5	6.0098	1.22203	307
SI1	2.6156	1.45818	307
SI3	3.1433	1.57149	307
ATT1	5.1401	1.68517	307
ATT2	5.3225	1.68526	307
INT1	5.6254	1.99175	307
INT2	4.6026	2.33159	307

Communalities

	Raw		Rescaled	
	Initial	Extraction	Initial	Extraction
SP2	3.255	1.856	1.000	.570
SP4	3.045	1.701	1.000	.559
SP5	2.901	1.382	1.000	.476
TIM1	2.944	1.808	1.000	.614
TIM5	3.869	3.020	1.000	.781
TIM6	3.353	2.686	1.000	.801
PRIV1	3.030	1.342	1.000	.443
PRIV2	2.293	1.369	1.000	.597
PRIV3	3.357	2.036	1.000	.606
FUNCT1	4.286	3.428	1.000	.800
FUNCT2	4.141	3.227	1.000	.779
FUNCT3	3.122	2.037	1.000	.653
SAF1	3.021	2.009	1.000	.665
SAF2	3.321	1.862	1.000	.561
SAF3	2.913	1.893	1.000	.650
EASE1	2.799	1.500	1.000	.536
EASE3	3.081	1.828	1.000	.593
EASE5	1.493	.619	1.000	.415
SI1	2.126	1.270	1.000	.597
SI3	2.470	1.781	1.000	.721
ATT1	2.840	1.947	1.000	.686
ATT2	2.840	1.962	1.000	.691
INT1	3.967	2.810	1.000	.708
INT2	5.436	4.825	1.000	.888

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Component	Initial Eigenvalues[a]			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Raw	1	20.119	26.506	26.506	20.119	26.506	26.506	14.543	19.161	19.161
	2	10.753	14.167	40.673	10.753	14.167	40.673	8.273	10.899	30.060
	3	6.823	8.990	49.663	6.823	8.990	49.663	8.860	11.673	41.733
	4	5.383	7.092	56.754	5.383	7.092	56.754	7.224	9.517	51.250
	5	3.945	5.198	61.952	3.945	5.198	61.952	4.088	5.386	56.636
	6	3.176	4.185	66.137	3.176	4.185	66.137	7.211	9.501	66.137
	7	2.712	3.573	69.710						
	8	2.426	3.197	72.906						
	9	2.023	2.665	75.572						
	10	1.926	2.537	78.109						
	11	1.870	2.464	80.573						
	12	1.655	2.181	82.753						
	13	1.611	2.123	84.876						
	14	1.508	1.987	86.863						
	15	1.378	1.816	88.679						
	16	1.333	1.756	90.435						
	17	1.224	1.613	92.047						
	18	1.094	1.441	93.488						
	19	1.052	1.386	94.875						
	20	.928	1.222	96.097						
	21	.915	1.206	97.303						
	22	.765	1.008	98.311						
	23	.747	.984	99.295						
	24	.535	.705	100.000						
Rescaled	1	20.119	26.506	26.506	6.657	27.738	27.738	4.860	20.248	20.248
	2	10.753	14.167	40.673	2.763	11.511	39.249	2.932	12.216	32.464
	3	6.823	8.990	49.663	1.886	7.859	47.108	2.287	9.528	41.992
	4	5.383	7.092	56.754	1.568	6.532	53.640	2.144	8.935	50.927
	5	3.945	5.198	61.952	1.236	5.150	58.790	1.606	6.692	57.619
	6	3.176	4.185	66.137	1.280	5.335	64.124	1.561	6.506	64.124
	7	2.712	3.573	69.710						
	8	2.426	3.197	72.906						
	9	2.023	2.665	75.572						
	10	1.926	2.537	78.109						
	11	1.870	2.464	80.573						
	12	1.655	2.181	82.753						
	13	1.611	2.123	84.876						
	14	1.508	1.987	86.863						
	15	1.378	1.816	88.679						
	16	1.333	1.756	90.435						
	17	1.224	1.613	92.047						
	18	1.094	1.441	93.488						
	19	1.052	1.386	94.875						
	20	.928	1.222	96.097						
	21	.915	1.206	97.303						
	22	.765	1.008	98.311						
	23	.747	.984	99.295						
	24	.535	.705	100.000						

Extraction Method: Principal Component Analysis.

a. When analyzing a covariance matrix, the initial eigenvalues are the same across the raw and rescaled solution.

Component Matrix[a]

	Raw						Rescaled					
	Component						Component					
	1	2	3	4	5	6	1	2	3	4	5	6
SP2	1.144						.634					
SP4	1.281						.734					
SP5	.928						.545					
TIM1	.798			-.586	.536	-.609	.465			-.341	.313	-.355
TIM5	1.221			-1.083	.593		.621			-.550	.302	
TIM6	1.100			-1.024	.623		.601			-.559	.340	
PRIV1	1.011						.581					
PRIV2	1.027						.678					
PRIV3	1.396						.762					
FUNCT1		1.430	1.091					.691	.527			
FUNCT2		1.362	1.142					.670	.561			
FUNCT3		1.119	.858					.633	.485			
SAF1	1.337						.769					
SAF2	1.286						.706					
SAF3	1.288						.755					
EASE1		.527		.505	.723			.315		.302	.432	
EASE3	.763		-.560	.603	.599		.435		-.319	.344	.342	
EASE5	.457		-.458				.374		-.375			
SI1						1.012						.694
SI3	.710					1.069	.452					.680
ATT1	1.010	.629					.599	.373				
ATT2	.949	.563		.646			.563	.334		.384		
INT1		1.095	-1.117					.550	-.561			
INT2		1.588	-.907	-.996				.681	-.389	-.427		

Extraction Method: Principal Component Analysis.

a. 6 components extracted.

Rotated Component Matrix[a]

	Raw						Rescaled					
	Component						Component					
	1	2	3	4	5	6	1	2	3	4	5	6
SP2	1.308						.725					
SP4	1.159						.664					
SP5	1.130						.663					
TIM1				1.163						.678		
TIM5				1.580						.803		
TIM6				1.535						.838		
PRIV1	1.102						.633					
PRIV2	1.134						.749					
PRIV3	1.270						.693					
FUNCT1			1.808						.873			
FUNCT2			1.766						.868			
FUNCT3			1.414						.800			
SAF1	1.276						.734					
SAF2	1.095						.601					
SAF3	1.264						.740					
EASE1		1.193						.713				
EASE3		1.321						.753				
EASE5		.691						.565				
SI1					1.096						.752	
SI3					1.232						.784	
ATT1	.516	1.240					.306	.736				
ATT2	.514	1.285					.305	.763				
INT1		.702				1.517		.352				.761
INT2						2.121						.910

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Component Transformation Matrix

Component	1	2	3	4	5	6
1	.796	.396	-.034	.393	.223	.067
2	-.172	.366	.720	-.067	.022	.559
3	.216	-.423	.688	.095	.077	-.535
4	.179	.507	.045	-.718	-.140	-.417
5	-.464	.521	.038	.538	-.071	-.466
6	-.206	.046	-.055	-.162	.959	-.081

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Structural Equation Modelling for ATM use

EQS, A STRUCTURAL EQUATION PROGRAM MULTIVARIATE SOFTWARE, INC.
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PROGRAM CONTROL INFORMATION

```
/TITLE
A:\web35a2.eqs 1/10/03 1
/SPECIFICATIONS
 DATA='a:\WEB35a2.ESS';
 VARIABLES= 9; CASES= 294;
 METHODS=ML;
 MATRIX=RAW;
V1=TIME; V2=SPACE; V3=PRIVACY; V4=SAFETY; V5=USEFUL;
V6=EASE; V7=SOCINT; V8=ATT; V9=INT;
/EQUATIONS
V8 = + *V1 + *V2 + *V3 + *V4 + *V5 + *V6 + *V7 + 1E8;
V9 = + *V2 + *V5 + *V6 + *V8 + 1E9;
/VARIANCES
V1 = *;
V2 = *;
V3 = *;
V4 = *;
V5 = *;
V6 = *;
V7 = *;
E8 = *;
E9 = *;
/COVARIANCES
V2 , V1 = *;
V3 , V1 = *;
V3 , V2 = *;
V4 , V1 = *;
V4 , V2 = *;
V4 , V3 = *;
V5 , V1 = *;
V5 , V2 = *;
V5 , V3 = *;
V5 , V4 = *;
V6 , V1 = *;
V6 , V2 = *;
V6 , V3 = *;
V6 , V4 = *;
V6 , V5 = *;
V7 , V1 = *;
V7 , V2 = *;
V7 , V3 = *;
V7 , V4 = *;
V7 , V5 = *;
V7 , V6 = *;
/LMTEST
 PROCESS=SIMULTANEOUS;
 SET=PVV,PFV,PFF,PDD,GVV,GVF,GFV,GFF,BVF,BFF;
/WTEST
 PVAL=0.05;
 PRIORITY=ZERO;
/PRINT
```

TITLE: A:\web35a2.eqs 1/10/03 1
EQS/EM386 Licensee: Division of Psychology   Serial #: E5722771634601

SAMPLE STATISTICS BASED ON COMPLETE CASES

UNIVARIATE STATISTICS

VARIABLE	TIME	SPACE	PRIVACY	SAFETY	USEFUL
MEAN	3.7206	4.2279	3.7611	4.2248	3.8769
SKEWNESS (G1)	0.4397	-0.0496	0.2756	0.0848	-0.0508
KURTOSIS (G2)	-0.3091	-0.5600	-0.6204	-0.8520	-0.9369
STANDARD DEV.	1.4409	1.4184	1.4891	1.5678	1.6637

VARIABLE	EASE	SOCINT	ATT	INT
MEAN	6.1362	3.5833	6.0459	4.6956
SKEWNESS (G1)	-1.7013	0.3826	-1.9841	-0.4676
KURTOSIS (G2)	3.5668	-0.4833	5.1944	-0.5180
STANDARD DEV.	1.0680	1.5073	1.1338	1.7763

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 24.4175
NORMALIZED ESTIMATE = 14.8769

ELLIPTICAL THEORY KURTOSIS ESTIMATES

MARDIA-BASED KAPPA = 0.2466 MEAN SCALED UNIVARIATE KURTOSIS = 0.1660

MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA= 0.2466

CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE KURTOSIS:

CASE NUMBER	127	129	149	154	191
ESTIMATE	1128.0808	1218.3522	606.4773	859.4169	1071.6022

	TIME	SPACE	PRIVACY	SAFETY	USEFUL
	V 1	V 2	V 3	V 4	V 5
TIME V 1	2.076				

SPACE V 2	0.768	2.012			
PRIVACY V 3	0.869	1.513	2.217		
SAFETY V 4	1.018	1.577	1.642	2.458	
USEFUL V 5	-0.175	-0.382	-0.285	-0.323	2.768
EASE V 6	0.303	0.501	0.318	0.458	0.044
SOCINT V 7	0.823	0.940	1.095	1.269	-0.051
ATT V 8	0.145	0.306	0.177	0.342	0.011
INT V 9	-0.006	0.020	-0.012	0.206	0.569

	EASE V 6	SOCINT V 7	ATT V 8	INT V 9
EASE V 6	1.141			
SOCINT V 7	0.442	2.272		
ATT V 8	0.572	0.283	1.285	
INT V 9	0.230	0.229	0.366	3.155

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 814.807 ON 36 DEGREES OF FREEDOM

INDEPENDENCE AIC = 742.80733 INDEPENDENCE CAIC = 574.19846
MODEL AIC = -4.19245 MODEL CAIC = -22.92676

CHI-SQUARE = 3.808 BASED ON 4 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.43268
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 3.783.

BENTLER-BONETT NORMED FIT INDEX= 0.995
BENTLER-BONETT NONNORMED FIT INDEX= 1.002
COMPARATIVE FIT INDEX (CFI) = 1.000
BOLLEN (IFI) FIT INDEX= 1.000
McDonald (MFI) FIT INDEX= 1.000
LISREL GFI FIT INDEX= 0.997
LISREL AGFI FIT INDEX= 0.968
ROOT MEAN SQUARED RESIDUAL (RMR) = 0.033
STANDARDIZED RMR = 0.012
ROOT MEAN SQ. ERROR OF APP.(RMSEA)= 0.000
90% CONFIDENCE INTERVAL OF RMSEA (0.000, 0.086)

MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS

```
ATT  =V8  =  -.028*V1   + .015*V2   - .056*V3   + .080*V4
              .046        .067        .062        .061
             -.611        .225       -.898       1.323

           + .001*V5   + .479*V6   + .018*V7   + 1.000 E8
              .036        .059        .048
              .019       8.134        .370

INT  =V9  =   .253*V8   - .008*V2   + .202*V5   + .070*V6
              .100        .076        .061        .111
             2.528       -.104       3.306        .630

           + 1.000 E9
```

VARIANCES OF INDEPENDENT VARIABLES

```
         V                    F
        ---                  ---
V1 - TIME         2.076*I                      I
              .172 I                  I
            12.104 I                   I
                 I                  I
V2 -SPACE          2.012*I                      I
              .166 I                  I
            12.104 I                   I
                 I                  I
V3 -PRIVACY         2.217*I                      I
              .183 I                  I
            12.104 I                   I
                 I                  I
V4 -SAFETY         2.458*I                      I
              .203 I                  I
            12.104 I                   I
                 I                  I
V5 -USEFUL         2.768*I                      I
              .229 I                  I
            12.104 I                   I
                 I                  I
V6 - EASE         1.141*I                      I
              .094 I                  I
            12.104 I                   I
                 I                  I
V7 -SOCINT         2.272*I                      I
              .188 I                  I
            12.104 I                   I
                 I                  I
```

VARIANCES OF INDEPENDENT VARIABLES

```
         E                    D
        ---                  ---
E8 - ATT          .988*I                      I
              .082 I                  I
            12.104 I                   I
                 I                  I
E9 - INT         2.932*I                      I
              .242 I                  I
            12.104 I                   I
                 I                  I
```

COVARIANCES AMONG INDEPENDENT VARIABLES

```
         V                    F
        ---                  ---
V2 -SPACE          .768*I                      I
V1 - TIME          .128 I                     I
             6.020 I                  I
```

```
                  I                    I
V3 -PRIVACY          .869*I                      I
V1 - TIME            .135 I                  I
             6.423 I                     I
                  I                    I
V4 -SAFETY          1.018*I                      I
V1 - TIME            .145 I                  I
             7.035 I                     I
                  I                    I
V5 -USEFUL          -.175*I                      I
V1 - TIME            .140 I                  I
            -1.244 I                     I
                  I                    I
V6 - EASE            .303*I                    I
V1 - TIME            .092 I                  I
             3.304 I                     I
                  I                    I
V7 -SOCINT           .823*I                     I
V1 - TIME            .136 I                  I
             6.064 I                     I
                  I                    I
V3 -PRIVACY         1.513*I                      I
V2 -SPACE            .152 I                    I
             9.969 I                     I
                  I                    I
V4 -SAFETY          1.577*I                      I
V2 -SPACE            .159 I                    I
             9.903 I                     I
                  I                    I
V5 -USEFUL          -.382*I                      I
V2 -SPACE            .140 I                    I
            -2.732 I                     I
                  I                    I
V6 - EASE            .501*I                    I
V2 -SPACE            .093 I                    I
             5.374 I                     I
                  I                    I
V7 -SOCINT           .940*I                     I
V2 -SPACE            .136 I                    I
             6.889 I                     I
                  I                    I
V4 -SAFETY          1.642*I                      I
V3 -PRIVACY          .167 I                      I
             9.848 I                     I
                  I                    I
```

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

COVARIANCES AMONG INDEPENDENT VARIABLES (CONTINUED)

```
--------------------------------------------------

V5 -USEFUL          -.285*I                      I
V3 -PRIVACY          .146 I                      I
            -1.959 I                     I
                  I                    I
V6 - EASE            .318*I                    I
V3 -PRIVACY          .095 I                      I
             3.358 I                     I
                  I                    I
```

```
V7 -SOCINT          1.095*I                    I
V3 -PRIVACY           .146 I                   I
               7.503 I                  I
                  I                  I
V5 -USEFUL           -.323*I                   I
V4 -SAFETY            .154 I                  I
              -2.107 I                  I
                  I                  I
V6 - EASE          .458*I                  I
V4 -SAFETY            .101 I                  I
               4.521 I                  I
                  I                  I
V7 -SOCINT          1.269*I                    I
V4 -SAFETY            .157 I                  I
               8.096 I                  I
                  I                  I
V6 - EASE          .044*I                  I
V5 -USEFUL            .104 I                  I
                .422 I                  I
                  I                  I
V7 -SOCINT           -.051*I                   I
V5 -USEFUL            .147 I                  I
               -.347 I                  I
                  I                  I
V7 -SOCINT            .442*I                   I
V6 - EASE          .098 I                  I
               4.528 I                  I
                  I                  I
```

STANDARDIZED SOLUTION: R-SQUARED

```
ATT  =V8 = -.036*V1  +.019*V2  -.073*V3  +.111*V4
       +.001*V5  +.452*V6  +.023*V7  +.877 E8       .231
INT  =V9 =  .162*V8  -.006*V2  +.189*V5  +.042*V6
       +.964 E9                                     .071
```

CORRELATIONS AMONG INDEPENDENT VARIABLES

```
          V                   F
         ---                 ---
V2 -SPACE          .376*I                    I
V1 - TIME             I                 I
                  I                  I
V3 -PRIVACY           .405*I                    I
V1 - TIME             I                 I
                  I                  I
V4 -SAFETY            .451*I                   I
V1 - TIME             I                 I
                  I                  I
V5 -USEFUL           -.073*I                   I
V1 - TIME             I                 I
                  I                  I
V6 - EASE          .197*I                  I
V1 - TIME             I                 I
                  I                  I
V7 -SOCINT            .379*I                   I
```

```
V1 - TIME             I                 I
                 I                 I
V3 -PRIVACY         .716*I                  I
V2 -SPACE             I                 I
                 I                 I
V4 -SAFETY         .709*I                  I
V2 -SPACE             I                 I
                 I                 I
V5 -USEFUL         -.162*I                 I
V2 -SPACE             I                 I
                 I                 I
V6 - EASE         .331*I                 I
V2 -SPACE             I                 I
                 I                 I
V7 -SOCINT         .440*I                  I
V2 -SPACE             I                 I
                 I                 I
V4 -SAFETY         .703*I                  I
V3 -PRIVACY           I                 I
                 I                 I
V5 -USEFUL         -.115*I                 I
V3 -PRIVACY           I                 I
                 I                 I
V6 - EASE         .200*I                 I
V3 -PRIVACY           I                 I
                 I                 I
V7 -SOCINT         .488*I                  I
V3 -PRIVACY           I                 I
                 I                 I
V5 -USEFUL         -.124*I                 I
V4 -SAFETY            I                 I


V6 - EASE         .274*I                 I
V4 -SAFETY            I                 I
                 I                 I
V7 -SOCINT         .537*I                  I
V4 -SAFETY            I                 I
                 I                 I
V6 - EASE         .025*I                 I
V5 -USEFUL            I                 I
                 I                 I
V7 -SOCINT         -.020*I                 I
V5 -USEFUL            I                 I
                 I                 I
V7 -SOCINT         .274*I                  I
V6 - EASE             I                 I
                 I                 I
```

END OF METHOD

WALD TEST (FOR DROPPING PARAMETERS)

MULTIVARIATE WALD TEST BY SIMULTANEOUS PROCESS

	CUMULATIVE MULTIVARIATE STATISTICS				UNIVARIATE INCREMENT	
STEP	PARAMETER	CHI-SQUARE	D.F.	PROBABILITY	CHI-SQUARE	PROBABILITY
1	V8,V5	0.000	1	0.985	0.000	0.985
2	V9,V2	0.011	2	0.994	0.011	0.918
3	V8,V2	0.061	3	0.996	0.050	0.823
4	V7,V5	0.181	4	0.996	0.120	0.729

LAGRANGIAN MULTIPLIER TEST REQUIRES 4449 WORDS OF MEMORY.
PROGRAM ALLOCATES 5000000 WORDS.

LAGRANGE MULTIPLIER TEST (FOR ADDING PARAMETERS)

ORDERED UNIVARIATE TEST STATISTICS:

NO	CODE	PARAMETER	CHI-SQUARE	PROBABILITY	PARAMETER CHANGE
1	2 11	V9,V4	2.256	0.133	0.136
2	2 11	V9,V7	1.155	0.282	0.080
3	2 11	V9,V1	0.030	0.863	-0.013
4	2 11	V9,V3	0.008	0.930	-0.008

***** NONE OF THE UNIVARIATE LAGRANGE MULTIPLIERS IS SIGNIFICANT,

Structural Equation Modelling for Mobile Telephone Use

```
1
 EQS, A STRUCTURAL EQUATION PROGRAM         MULTIVARIATE SOFTWARE, INC.
 COPYRIGHT BY P.M. BENTLER              VERSION 5.7b (C) 1985 - 1998.


  PROGRAM CONTROL INFORMATION

   /TITLE
   A:\web35a3.eqs 1/10/03 1
   /SPECIFICATIONS
    DATA='a:\WEB35a3.ESS';
    VARIABLES= 9; CASES= 242;
    METHODS=ML;
    MATRIX=RAW;
   /LABELS
   V1=TIME; V2=SPACE; V3=PRIVACY; V4=SAFETY; V5=USEFUL;
   V6=EASE; V7=SOCINT; V8=ATT; V9=INT;
   /EQUATIONS
   V8 = + *V1 + *V2 + *V3 + *V4 + *V5 + *V6 + *V7 + 1E8;
   V9 = + *V2 + *V5 + *V6 + *V8 + 1E9;
   /VARIANCES
   V1 = *;
   V2 = *;
   V3 = *;
   V4 = *;
   V5 = *;
   V6 = *;
   V7 = *;
   E8 = *;
   E9 = *;
   /COVARIANCES
   V2 , V1 = *;
   V3 , V1 = *;
   V3 , V2 = *;
   V4 , V1 = *;
   V4 , V2 = *;
   V4 , V3 = *;
   V5 , V1 = *;
   V5 , V2 = *;
   V5 , V3 = *;
   V5 , V4 = *;
   V6 , V1 = *;
   V6 , V2 = *;
   V6 , V3 = *;
   V6 , V4 = *;
   V6 , V5 = *;
   V7 , V1 = *;
   V7 , V2 = *;
   V7 , V3 = *;
   V7 , V4 = *;
   V7 , V5 = *;
   V7 , V6 = *;
   /LMTEST
    PROCESS=SIMULTANEOUS;
    SET=PVV,PFV,PFF,PDD,GVV,GVF,GFV,GFF,BVF,BFF;
   /WTEST
    PVAL=0.05;
```

```
51  PRIORITY=ZERO;
52  /PRINT
```

DATA IS READ FROM A:\WEB35A3.ESS
THERE ARE 9 VARIABLES AND 242 CASES
IT IS A RAW DATA ESS FILE

SAMPLE STATISTICS BASED ON COMPLETE CASES

UNIVARIATE STATISTICS

VARIABLE	TIME	SPACE	PRIVACY	SAFETY	USEFUL
MEAN	3.3844	4.4979	3.0000	4.9697	4.0526
SKEWNESS (G1)	0.1313	0.1718	0.5689	-0.2703	-0.1288
KURTOSIS (G2)	-0.4519	-0.2850	0.1284	-0.7635	-0.5360
STANDARD DEV.	1.3302	1.1691	1.2381	1.3747	1.5161

VARIABLE	EASE	SOCINT	ATT	INT
MEAN	5.4202	3.7789	5.2748	4.5186
SKEWNESS (G1)	-0.6745	0.0345	-0.6069	-0.3827
KURTOSIS (G2)	-0.3452	-0.4054	-0.2962	-0.6588
STANDARD DEV.	1.3576	1.4243	1.2851	1.8346

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 7.9026
NORMALIZED ESTIMATE = 4.3683

ELLIPTICAL THEORY KURTOSIS ESTIMATES

MARDIA-BASED KAPPA = 0.0798 MEAN SCALED UNIVARIATE KURTOSIS = -0.1338

MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA= 0.0798

CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE KURTOSIS:

CASE NUMBER	86	133	139	187	219
ESTIMATE	228.0590	320.6386	232.9826	478.0738	281.1361

COVARIANCE MATRIX TO BE ANALYZED: 9 VARIABLES (SELECTED FROM 9 VARIABLES)
BASED ON 242 CASES.

		TIME	SPACE	PRIVACY	SAFETY	USEFUL
		V 1	V 2	V 3	V 4	V 5
TIME	V 1	1.769				
SPACE	V 2	0.741	1.367			
PRIVACY	V 3	0.947	0.692	1.533		
SAFETY	V 4	0.843	0.750	0.567	1.890	
USEFUL	V 5	0.496	0.160	0.309	0.417	2.298
EASE	V 6	0.405	0.452	0.201	0.665	0.685
SOCINT	V 7	0.915	0.582	0.662	0.785	0.121
ATT	V 8	0.394	0.480	0.423	0.541	0.738
INT	V 9	0.435	0.360	0.344	0.724	1.193

		EASE	SOCINT	ATT	INT
		V 6	V 7	V 8	V 9
EASE	V 6	1.843			
SOCINT	V 7	0.352	2.029		
ATT	V 8	0.739	0.256	1.651	
INT	V 9	0.732	0.327	0.896	3.366

BENTLER-WEEKS STRUCTURAL REPRESENTATION:

NUMBER OF DEPENDENT VARIABLES = 2
DEPENDENT V'S : 8 9

NUMBER OF INDEPENDENT VARIABLES = 9
INDEPENDENT V'S : 1 2 3 4 5 6 7
INDEPENDENT E'S : 8 9

NUMBER OF FREE PARAMETERS = 41
NUMBER OF FIXED NONZERO PARAMETERS = 2

3RD STAGE OF COMPUTATION REQUIRED 4603 WORDS OF MEMORY.
PROGRAM ALLOCATED 5000000 WORDS

DETERMINANT OF INPUT MATRIX IS 0.29177E+02

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 587.939 ON 36 DEGREES OF FREEDOM

INDEPENDENCE AIC = 515.93907 INDEPENDENCE CAIC = 354.33731
MODEL AIC = -2.48837 MODEL CAIC = -20.44412

CHI-SQUARE = 5.512 BASED ON 4 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.23871
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 5.449.

BENTLER-BONETT NORMED FIT INDEX= 0.991
BENTLER-BONETT NONNORMED FIT INDEX= 0.975
COMPARATIVE FIT INDEX (CFI) = 0.997

```
BOLLEN (IFI)          FIT INDEX=    0.997
McDonald (MFI)         FIT INDEX=    0.997
LISREL GFI            FIT INDEX=    0.995
LISREL AGFI            FIT INDEX=    0.944
ROOT MEAN SQUARED RESIDUAL (RMR) =     0.044
STANDARDIZED RMR               =    0.017
ROOT MEAN SQ. ERROR OF APP.(RMSEA)=    0.040
90% CONFIDENCE INTERVAL OF RMSEA (     0.000,      0.111)
```

MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS

```
ATT  =V8  =  -.071*V1   + .174*V2   + .147*V3   + .079*V4
             .072        .075        .072        .063
            -.983       2.327       2.043       1.256

           + .216*V5   + .254*V6   - .027*V7   + 1.000 E8
             .050        .058        .058
            4.327       4.395       -.471

INT  =V9  =   .297*V8   + .076*V2   + .383*V5   + .117*V6
             .094        .094        .075        .087
            3.148        .806       5.125       1.346

           + 1.000 E9
```

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

```
STANDARDIZED SOLUTION:                                  R-SQUARED


ATT  =V8  = -.074*V1   + .159*V2   + .142*V3   + .084*V4
           + .255*V5   + .269*V6   - .030*V7   + .835 E8        .303
INT  =V9  =  .208*V8   + .048*V2   + .317*V5   + .086*V6
           + .867 E9                                 .248
```

CORRELATIONS AMONG INDEPENDENT VARIABLES

```
          V                    F
         ---                  ---
V2 -SPACE          .476*I                  I
V1 - TIME            I                 I
               I              I
V3 -PRIVACY         .575*I                  I
V1 - TIME            I                 I
               I              I
V4 -SAFETY          .461*I                  I
V1 - TIME            I                 I
               I              I
```

```
V5 -USEFUL        .246*I              I
V1 - TIME           I               I
                I                 I
V6 - EASE        .224*I              I
V1 - TIME           I               I
                I                 I
V7 -SOCINT       .483*I              I
V1 - TIME           I               I
                I                 I
V3 -PRIVACY       .478*I              I
V2 -SPACE           I               I
                I                 I
V4 -SAFETY       .467*I              I
V2 -SPACE           I               I
                I                 I
V5 -USEFUL       .090*I              I
V2 -SPACE           I               I
                I                 I
V6 - EASE        .285*I              I
V2 -SPACE           I               I
                I                 I
V7 -SOCINT       .349*I              I
V2 -SPACE           I               I
                I                 I
V4 -SAFETY       .333*I              I
V3 -PRIVACY          I               I
                I                 I
V5 -USEFUL       .165*I              I
V3 -PRIVACY          I               I
                I                 I
V6 - EASE        .120*I              I
V3 -PRIVACY          I               I
                I                 I
V7 -SOCINT       .375*I              I
V3 -PRIVACY          I               I
                I                 I
V5 -USEFUL       .200*I              I
V4 -SAFETY           I               I
                I                 I

V6 - EASE        .357*I              I
V4 -SAFETY           I               I
                I                 I
V7 -SOCINT       .401*I              I
V4 -SAFETY           I               I
                I                 I
V6 - EASE        .333*I              I
V5 -USEFUL           I               I
                I                 I
V7 -SOCINT       .056*I              I
V5 -USEFUL           I               I
                I                 I
V7 -SOCINT       .182*I              I
V6 - EASE           I               I
                I                 I

------------------------------------------------------------------------
              E N D   O F   M E T H O D
------------------------------------------------------------------------
```

WALD TEST (FOR DROPPING PARAMETERS)
MULTIVARIATE WALD TEST BY SIMULTANEOUS PROCESS

	CUMULATIVE MULTIVARIATE STATISTICS				UNIVARIATE INCREMENT	
STEP	PARAMETER	CHI-SQUARE	D.F.	PROBABILITY	CHI-SQUARE	PROBABILITY
1	V8,V7	0.221	1	0.638	0.221	0.638
2	V9,V2	0.871	2	0.647	0.649	0.420
3	V7,V5	1.620	3	0.655	0.749	0.387
4	V8,V1	2.951	4	0.566	1.331	0.249

EQS/EM386 Licensee: Division of Psychology
MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

LAGRANGIAN MULTIPLIER TEST REQUIRES 4449 WORDS OF MEMORY.
PROGRAM ALLOCATES 5000000 WORDS.

LAGRANGE MULTIPLIER TEST (FOR ADDING PARAMETERS)

ORDERED UNIVARIATE TEST STATISTICS:

NO	CODE		PARAMETER	CHI-SQUARE	PROBABILITY	PARAMETER CHANGE
1	2	11	V9,V4	5.064	0.024	0.198
2	2	11	V9,V7	0.767	0.381	0.068
3	2	11	V9,V3	0.049	0.825	0.021
4	2	11	V9,V1	0.043	0.836	0.019

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

MULTIVARIATE LAGRANGE MULTIPLIER TEST BY SIMULTANEOUS PROCESS IN STAGE 1

PARAMETER SETS (SUBMATRICES) ACTIVE AT THIS STAGE ARE:

PVV PFV PFF PDD GVV GVF GFV GFF BVF BFF

	CUMULATIVE MULTIVARIATE STATISTICS				UNIVARIATE INCREMENT	
STEP	PARAMETER	CHI-SQUARE	D.F.	PROBABILITY	CHI-SQUARE	PROBABILITY
1	V9,V4	5.064	1	0.024	5.064	0.024

APPENDIX D

REGRESSION AND RELIABILITY OUTPUTS FOR INDIVIDUAL DIIFERENCES DATA REPORTED IN CHAPTER 7.

ATM Privacy

Descriptive Statistics[a]

	Mean	Std. Deviation	N
PRIVACY	3.7613	1.4890	294
TOLERAFA	1.3350	.3186	294
NOVSEFA	1.2228	.3041	294
EMPATHFA	1.1942	.2180	294
ANXIETFA	1.5969	.2953	294
DOMINAFA	1.4172	.3699	294
EXTROFA	1.55238	.31031	294
SOCINTFA	1.3257	.2862	294

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: PRIVACY

b. Models are based only on cases for which NTILES of TYPE = 2.00

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	NTILES of TYPE = 2.00 (Selected)				R Square Change	F Change	df1	df2	Sig. F Change
1	.187[a]	.035	.032	1.4652	.035	10.611	1	292	.001

a. Predictors: (Constant), ANXIETFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.779	1	22.779	10.611	.001[a]
	Residual	626.836	292	2.147		
	Total	649.615	293			

a. Predictors: (Constant), ANXIETFA

b. Dependent Variable: PRIVACY

c. Selecting only cases for which NTILES of TYPE = 2.00

Coefficients[a,b]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.253	.471		4.786	.000
	ANXIETFA	.944	.290	.187	3.257	.001

a. Dependent Variable: PRIVACY

b. Selecting only cases for which NTILES of TYPE = 2.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	.013[a]	.211	.833	.012	.930
	NOVSEFA	.018[a]	.310	.757	.018	.957
	EMPATHFA	.039[a]	.676	.499	.040	1.000
	DOMINAFA	-.002[a]	-.027	.978	-.002	.998
	EXTROFA	-.065[a]	-1.123	.262	-.066	.999
	SOCINTFA	-.054[a]	-.946	.345	-.055	1.000

a. Predictors in the Model: (Constant), ANXIETFA

b. Dependent Variable: PRIVACY

ATM Time Pressure

Descriptive Statistics[a]

	Mean	Std. Deviation	N
TIME	3.7205	1.4409	294
TOLERAFA	1.3350	.3186	294
NOVSEFA	1.2228	.3041	294
EMPATHFA	1.1942	.2180	294
ANXIETFA	1.5969	.2953	294
DOMINAFA	1.4172	.3699	294
EXTROFA	1.55238	.31031	294
SOCINTFA	1.3257	.2862	294

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: TIME

b. Models are based only on cases for which NTILES of TYPE = 2.00

Model Summary

Model	R NTILES of TYPE = 2.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.188[a]	.035	.032	1.4177	.035	10.662	1	292	.001

a. Predictors: (Constant), ANXIETFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21.429	1	21.429	10.662	.001[a]
	Residual	586.857	292	2.010		
	Total	608.286	293			

a. Predictors: (Constant), ANXIETFA

b. Dependent Variable: TIME

c. Selecting only cases for which NTILES of TYPE = 2.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.258	.456		4.957	.000
	ANXIETFA	.916	.281	.188	3.265	.001

a. Dependent Variable: TIME

b. Selecting only cases for which NTILES of TYPE = 2.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.022[a]	-.364	.716	-.021	.930
	NOVSEFA	-.042[a]	-.722	.471	-.042	.957
	EMPATHFA	-.001[a]	-.018	.985	-.001	1.000
	DOMINAFA	-.093[a]	-1.615	.107	-.094	.998
	EXTROFA	-.075[a]	-1.307	.192	-.076	.999
	SOCINTFA	.018[a]	.315	.753	.018	1.000

a. Predictors in the Model: (Constant), ANXIETFA

b. Dependent Variable: TIME

ATM Usefulness

Descriptive Statistics[a]

	Mean	Std. Deviation	N
USEFUL	3.8770	1.6635	294
TOLERAFA	1.3350	.3186	294
NOVSEFA	1.2228	.3041	294
EMPATHFA	1.1942	.2180	294
ANXIETFA	1.5969	.2953	294
DOMINAFA	1.4172	.3699	294
EXTROFA	1.55238	.31031	294
SOCINTFA	1.3257	.2862	294

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

a. Dependent Variable: USEFUL

b. Models are based only on cases for which NTILES of TYPE = 2.00

ATM Space

Descriptive Statistics[a]

	Mean	Std. Deviation	N
SPACE	4.2279	1.4185	294
TOLERAFA	1.3350	.3186	294
NOVSEFA	1.2228	.3041	294
EMPATHFA	1.1942	.2180	294
ANXIETFA	1.5969	.2953	294
DOMINAFA	1.4172	.3699	294
EXTROFA	1.55238	.31031	294
SOCINTFA	1.3257	.2862	294

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: SPACE

b. Models are based only on cases for which NTILES of TYPE = 2.00

Model Summary

Model	R NTILES of TYPE = 2.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.200[a]	.040	.037	1.3922	.040	12.170	1	292	.001

a. Predictors: (Constant), ANXIETFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.590	1	23.590	12.170	.001[a]
	Residual	565.975	292	1.938		
	Total	589.565	293			

a. Predictors: (Constant), ANXIETFA

b. Dependent Variable: SPACE

c. Selecting only cases for which NTILES of TYPE = 2.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.693	.447		6.021	.000
	ANXIETFA	.961	.275	.200	3.489	.001

a. Dependent Variable: SPACE

b. Selecting only cases for which NTILES of TYPE = 2.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	TOLERAFA	-.010[a]	-.175	.861	-.010	.930
	NOVSEFA	.000[a]	-.006	.996	.000	.957
	EMPATHFA	.032[a]	.565	.573	.033	1.000
	DOMINAFA	.053[a]	.931	.352	.055	.998
	EXTROFA	-.062[a]	-1.076	.283	-.063	.999
	SOCINTFA	-.034[a]	-.591	.555	-.035	1.000

a. Predictors in the Model: (Constant), ANXIETFA

b. Dependent Variable: SPACE

ATM Safety

Descriptive Statistics[a]

	Mean	Std. Deviation	N
SAFETY	4.2251	1.5675	294
TOLERAFA	1.3350	.3186	294
NOVSEFA	1.2228	.3041	294
EMPATHFA	1.1942	.2180	294
ANXIETFA	1.5969	.2953	294
DOMINAFA	1.4172	.3699	294
EXTROFA	1.55238	.31031	294
SOCINTFA	1.3257	.2862	294

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: SAFETY

b. Models are based only on cases for which NTILES of TYPE = 2.00

Model Summary

Model	R NTILES of TYPE = 2.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.278[a]	.078	.074	1.5081	.078	24.534	1	292	.000

a. Predictors: (Constant), ANXIETFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	55.799	1	55.799	24.534	.000[a]
	Residual	664.116	292	2.274		
	Total	719.914	293			

a. Predictors: (Constant), ANXIETFA

b. Dependent Variable: SAFETY

c. Selecting only cases for which NTILES of TYPE = 2.00

Coefficients[a,b]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.865	.485		3.848	.000
	ANXIETFA	1.478	.298	.278	4.953	.000

a. Dependent Variable: SAFETY

b. Selecting only cases for which NTILES of TYPE = 2.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.072[a]	-1.229	.220	-.072	.930
	NOVSEFA	-.028[a]	-.490	.625	-.029	.957
	EMPATHFA	.002[a]	.035	.972	.002	1.000
	DOMINAFA	.028[a]	.493	.622	.029	.998
	EXTROFA	-.054[a]	-.967	.334	-.057	.999
	SOCINTFA	.012[a]	.211	.833	.012	1.000

a. Predictors in the Model: (Constant), ANXIETFA

b. Dependent Variable: SAFETY

ATM Ease

Descriptive Statistics[a]

	Mean	Std. Deviation	N
EASE	6.1361	1.0679	294
TOLERAFA	1.3350	.3186	294
NOVSEFA	1.2228	.3041	294
EMPATHFA	1.1942	.2180	294
ANXIETFA	1.5969	.2953	294
DOMINAFA	1.4172	.3699	294
EXTROFA	1.55238	.31031	294
SOCINTFA	1.3257	.2862	294

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	SOCINTFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: EASE

b. Models are based only on cases for which NTILES of TYPE = 2.00

Model Summary

Model	R NTILES of TYPE = 2.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.128[a]	.016	.013	1.0609	.016	4.872	1	292	.028
2	.176[b]	.031	.024	1.0547	.015	4.423	1	291	.036

a. Predictors: (Constant), SOCINTFA

b. Predictors: (Constant), SOCINTFA, ANXIETFA

ANOVA[c,d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.484	1	5.484	4.872	.028[a]
	Residual	328.630	292	1.125		
	Total	334.113	293			
2	Regression	10.403	2	5.202	4.676	.010[b]
	Residual	323.710	291	1.112		
	Total	334.113	293			

a. Predictors: (Constant), SOCINTFA

b. Predictors: (Constant), SOCINTFA, ANXIETFA

c. Dependent Variable: EASE

d. Selecting only cases for which NTILES of TYPE = 2.00

Coefficients[a,b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	5.502	.294		18.738	.000
	SOCINTFA	.478	.217	.128	2.207	.028
2	(Constant)	4.790	.447		10.712	.000
	SOCINTFA	.487	.215	.130	2.260	.025
	ANXIETFA	.439	.209	.121	2.103	.036

a. Dependent Variable: EASE

b. Selecting only cases for which NTILES of TYPE = 2.00

Excluded Variables[c]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.052[a]	-.879	.380	-.051	.982
	NOVSEFA	-.096[a]	-1.629	.104	-.095	.971
	EMPATHFA	-.041[a]	-.668	.504	-.039	.912
	ANXIETFA	.121[a]	2.103	.036	.122	1.000
	DOMINAFA	-.018[a]	-.294	.769	-.017	.937
	EXTROFA	-.021[a]	-.301	.764	-.018	.712
2	TOLERAFA	-.021[b]	-.341	.733	-.020	.913
	NOVSEFA	-.073[b]	-1.227	.221	-.072	.929
	EMPATHFA	-.044[b]	-.732	.465	-.043	.911
	DOMINAFA	-.013[b]	-.221	.825	-.013	.936
	EXTROFA	-.017[b]	-.249	.804	-.015	.712

a. Predictors in the Model: (Constant), SOCINTFA

b. Predictors in the Model: (Constant), SOCINTFA, ANXIETFA

c. Dependent Variable: EASE

ATM Social Interaction

Descriptive Statistics[a]

	Mean	Std. Deviation	N
SOCINTER	3.5833	1.5073	294
TOLERAFA	1.3350	.3186	294
NOVSEFA	1.2228	.3041	294
EMPATHFA	1.1942	.2180	294
ANXIETFA	1.5969	.2953	294
DOMINAFA	1.4172	.3699	294
EXTROFA	1.55238	.31031	294
SOCINTFA	1.3257	.2862	294

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: SOCINTER

b. Models are based only on cases for which NTILES of TYPE = 2.00

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	NTILES of TYPE = 2.00 (Selected)				R Square Change	F Change	df1	df2	Sig. F Change
1	.131[a]	.017	.014	1.4969	.017	5.099	1	292	.025

a. Predictors: (Constant), ANXIETFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.426	1	11.426	5.099	.025[a]
	Residual	654.283	292	2.241		
	Total	665.708	293			

a. Predictors: (Constant), ANXIETFA

b. Dependent Variable: SOCINTER

c. Selecting only cases for which NTILES of TYPE = 2.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.515	.481		5.230	.000
	ANXIETFA	.669	.296	.131	2.258	.025

a. Dependent Variable: SOCINTER

b. Selecting only cases for which NTILES of TYPE = 2.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	TOLERAFA	-.008[a]	-.138	.890	-.008	.930
	NOVSEFA	-.085[a]	-1.433	.153	-.084	.957
	EMPATHFA	-.021[a]	-.355	.723	-.021	1.000
	DOMINAFA	-.021[a]	-.356	.722	-.021	.998
	EXTROFA	-.079[a]	-1.356	.176	-.079	.999
	SOCINTFA	-.066[a]	-1.131	.259	-.066	1.000

a. Predictors in the Model: (Constant), ANXIETFA

b. Dependent Variable: SOCINTER

ATM Attitude

Descriptive Statistics[a]

	Mean	Std. Deviation	N
ATTITUDE	6.0459	1.1338	294
TOLERAFA	1.3350	.3186	294
NOVSEFA	1.2228	.3041	294
EMPATHFA	1.1942	.2180	294
ANXIETFA	1.5969	.2953	294
DOMINAFA	1.4172	.3699	294
EXTROFA	1.55238	.31031	294
SOCINTFA	1.3257	.2862	294

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	NOVSEFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: ATTITUDE

b. Models are based only on cases for which NTILES of TYPE = 2.00

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	NTILES of TYPE = 2.00 (Selected)				R Square Change	F Change	df1	df2	Sig. F Change
1	.123[a]	.015	.012	1.1271	.015	4.472	1	292	.035

a. Predictors: (Constant), NOVSEFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.682	1	5.682	4.472	.035[a]
	Residual	370.948	292	1.270		
	Total	376.630	293			

a. Predictors: (Constant), NOVSEFA

b. Dependent Variable: ATTITUDE

c. Selecting only cases for which NTILES of TYPE = 2.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.486	.273		20.112	.000
	NOVSEFA	.458	.217	.123	2.115	.035

a. Dependent Variable: ATTITUDE

b. Selecting only cases for which NTILES of TYPE = 2.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.045[a]	-.758	.449	-.044	.968
	EMPATHFA	-.033[a]	-.562	.575	-.033	.963
	ANXIETFA	.030[a]	.502	.616	.029	.957
	DOMINAFA	.035[a]	.553	.581	.032	.866
	EXTROFA	-.006[a]	-.098	.922	-.006	.905
	SOCINTFA	.099[a]	1.678	.094	.098	.971

a. Predictors in the Model: (Constant), NOVSEFA

b. Dependent Variable: ATTITUDE

ATM Intention

Descriptive Statistics[a]

	Mean	Std. Deviation	N
INTENT	4.7116	1.7579	293
TOLERAFA	1.3353	.3191	293
NOVSEFA	1.2235	.3044	293
EMPATHFA	1.1948	.2181	293
ANXIETFA	1.5981	.2951	293
DOMINAFA	1.4187	.3698	293
EXTROFA	1.55427	.30915	293
SOCINTFA	1.3268	.2861	293

a. Selecting only cases for which NTILES of TYPE = 2.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EMPATHFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: INTENT

b. Models are based only on cases for which NTILES of TYPE = 2.00

Model Summary

Model	R NTILES of TYPE = 2.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.259[a]	.067	.064	1.7007	.067	20.994	1	291	.000

a. Predictors: (Constant), EMPATHFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	60.722	1	60.722	20.994	.000[a]
	Residual	841.659	291	2.892		
	Total	902.381	292			

a. Predictors: (Constant), EMPATHFA

b. Dependent Variable: INTENT

c. Selecting only cases for which NTILES of TYPE = 2.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.210	.554		13.008	.000
	EMPATHFA	-2.091	.456	-.259	-4.582	.000

a. Dependent Variable: INTENT

b. Selecting only cases for which NTILES of TYPE = 2.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	TOLERAFA	-.005[a]	-.082	.935	-.005	.836
	NOVSEFA	-.015[a]	-.261	.794	-.015	.964
	ANXIETFA	-.080[a]	-1.417	.157	-.083	1.000
	DOMINAFA	.049[a]	.847	.398	.050	.958
	EXTROFA	.057[a]	.952	.342	.056	.896
	SOCINTFA	-.049[a]	-.823	.411	-.048	.913

a. Predictors in the Model: (Constant), EMPATHFA

b. Dependent Variable: INTENT

Mobile Telephone Privacy

Descriptive Statistics[a]

	Mean	Std. Deviation	N
PRIVACY	3.0000	1.2379	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EXTROFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: PRIVACY

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R NTILES of TYPE = 4.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.176[a]	.031	.027	1.2212	.031	7.669	1	240	.006

a. Predictors: (Constant), EXTROFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.436	1	11.436	7.669	.006[a]
	Residual	357.897	240	1.491		
	Total	369.333	241			

a. Predictors: (Constant), EXTROFA

b. Dependent Variable: PRIVACY

c. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.028	.379		10.619	.000
	EXTROFA	-.683	.247	-.176	-2.769	.006

a. Dependent Variable: PRIVACY

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.003[a]	-.051	.959	-.003	.996
	NOVSEFA	.000[a]	-.004	.997	.000	.912
	EMPATHFA	-.031[a]	-.471	.638	-.030	.929
	ANXIETFA	.094[a]	1.489	.138	.096	1.000
	DOMINAFA	-.046[a]	-.571	.569	-.037	.629
	SOCINTFA	-.014[a]	-.183	.855	-.012	.731

a. Predictors in the Model: (Constant), EXTROFA

b. Dependent Variable: PRIVACY

Mobile Telephone Time Pressure

Descriptive Statistics[a]

	Mean	Std. Deviation	N
TIME	3.3843	1.3300	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EXTROFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: TIME

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R NTILES of TYPE = 4.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.141[a]	.020	.016	1.3195	.020	4.860	1	240	.028

a. Predictors: (Constant), EXTROFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.461	1	8.461	4.860	.028[a]
	Residual	417.855	240	1.741		
	Total	426.316	241			

a. Predictors: (Constant), EXTROFA

b. Dependent Variable: TIME

c. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.268	.410		10.415	.000
	EXTROFA	-.588	.267	-.141	-2.204	.028

a. Dependent Variable: TIME

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	TOLERAFA	-.047[a]	-.736	.462	-.048	.996
	NOVSEFA	-.025[a]	-.380	.704	-.025	.912
	EMPATHFA	-.034[a]	-.517	.606	-.033	.929
	ANXIETFA	.115[a]	1.814	.071	.117	1.000
	DOMINAFA	-.082[a]	-1.020	.309	-.066	.629
	SOCINTFA	.040[a]	.537	.592	.035	.731

a. Predictors in the Model: (Constant), EXTROFA

b. Dependent Variable: TIME

Mobile Telephone Usefulness

Descriptive Statistics[a]

	Mean	Std. Deviation	N
USEFUL	4.0523	1.5159	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EMPATHFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: USEFUL

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R NTILES of TYPE = 4.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.213[a]	.045	.041	1.4841	.045	11.427	1	240	.001

a. Predictors: (Constant), EMPATHFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	25.168	1	25.168	11.427	.001[a]
	Residual	528.614	240	2.203		
	Total	553.781	241			

a. Predictors: (Constant), EMPATHFA

b. Dependent Variable: USEFUL

c. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.779	.519		11.123	.000
	EMPATHFA	-1.468	.434	-.213	-3.380	.001

a. Dependent Variable: USEFUL

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	TOLERAFA	.036[a]	.529	.597	.034	.865
	NOVSEFA	-.015[a]	-.233	.816	-.015	.983
	ANXIETFA	-.080[a]	-1.273	.204	-.082	.998
	DOMINAFA	-.119[a]	-1.891	.060	-.121	.997
	EXTROFA	-.071[a]	-1.085	.279	-.070	.929
	SOCINTFA	.000[a]	.004	.997	.000	.899

a. Predictors in the Model: (Constant), EMPATHFA

b. Dependent Variable: USEFUL

Mobile Telephone Space

Descriptive Statistics[a]

	Mean	Std. Deviation	N
SPACE	4.4978	1.1690	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EXTROFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: SPACE

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	NTILES of TYPE = 4.00 (Selected)				R Square Change	F Change	df1	df2	Sig. F Change
1	.249[a]	.062	.058	1.1346	.062	15.803	1	240	.000

a. Predictors: (Constant), EXTROFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	20.345	1	20.345	15.803	.000[a]
	Residual	308.978	240	1.287		
	Total	329.323	241			

a. Predictors: (Constant), EXTROFA

b. Dependent Variable: SPACE

c. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.868	.352		16.653	.000
	EXTROFA	-.912	.229	-.249	-3.975	.000

a. Dependent Variable: SPACE

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.069[a]	-1.098	.273	-.071	.996
	NOVSEFA	.018[a]	.272	.786	.018	.912
	EMPATHFA	-.039[a]	-.605	.546	-.039	.929
	ANXIETFA	.116[a]	1.871	.063	.120	1.000
	DOMINAFA	-.024[a]	-.309	.758	-.020	.629
	SOCINTFA	.038[a]	.520	.603	.034	.731

a. Predictors in the Model: (Constant), EXTROFA

b. Dependent Variable: SPACE

Mobile Telephone Safety

Descriptive Statistics[a]

	Mean	Std. Deviation	N
SAFETY	4.9697	1.3745	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EXTROFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: SAFETY

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R NTILES of TYPE = 4.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.290[a]	.084	.080	1.3183	.084	22.017	1	240	.000
2	.326[b]	.106	.099	1.3047	.022	5.996	1	239	.015

a. Predictors: (Constant), EXTROFA

b. Predictors: (Constant), EXTROFA, ANXIETFA

ANOVA[c,d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38.262	1	38.262	22.017	.000[a]
	Residual	417.071	240	1.738		
	Total	455.333	241			
2	Regression	48.470	2	24.235	14.236	.000[b]
	Residual	406.863	239	1.702		
	Total	455.333	241			

a. Predictors: (Constant), EXTROFA

b. Predictors: (Constant), EXTROFA, ANXIETFA

c. Dependent Variable: SAFETY

d. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	6.849	.409		16.729	.000
	EXTROFA	-1.250	.266	-.290	-4.692	.000
2	(Constant)	5.714	.616		9.277	.000
	EXTROFA	-1.244	.264	-.288	-4.717	.000
	ANXIETFA	.720	.294	.150	2.449	.015

a. Dependent Variable: SAFETY

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[c]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.068[a]	-1.099	.273	-.071	.996
	NOVSEFA	.006[a]	.099	.921	.006	.912
	EMPATHFA	-.039[a]	-.602	.548	-.039	.929
	ANXIETFA	.150[a]	2.449	.015	.156	1.000
	DOMINAFA	-.035[a]	-.448	.655	-.029	.629
	SOCINTFA	.067[a]	.928	.355	.060	.731
2	TOLERAFA	-.033[b]	-.520	.603	-.034	.936
	NOVSEFA	.051[b]	.762	.447	.049	.851
	EMPATHFA	-.046[b]	-.720	.472	-.047	.927
	DOMINAFA	-.017[b]	-.221	.825	-.014	.624
	SOCINTFA	.077[b]	1.081	.281	.070	.729

a. Predictors in the Model: (Constant), EXTROFA

b. Predictors in the Model: (Constant), EXTROFA, ANXIETFA

c. Dependent Variable: SAFETY

Mobile Telephone Ease

Descriptive Statistics[a]

	Mean	Std. Deviation	N
EASE	5.4201	1.3574	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EXTROFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: EASE

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	NTILES of TYPE = 4.00 (Selected)				R Square Change	F Change	df1	df2	Sig. F Change
1	.149[a]	.022	.018	1.3450	.022	5.476	1	240	.020

a. Predictors: (Constant), EXTROFA

ANOVA[b,c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.906	1	9.906	5.476	.020[a]
	Residual	434.161	240	1.809		
	Total	444.067	241			

a. Predictors: (Constant), EXTROFA

b. Dependent Variable: EASE

c. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	6.376	.418		15.265	.000
	EXTROFA	-.636	.272	-.149	-2.340	.020

a. Dependent Variable: EASE

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.058[a]	-.899	.369	-.058	.996
	NOVSEFA	-.026[a]	-.386	.700	-.025	.912
	EMPATHFA	-.051[a]	-.777	.438	-.050	.929
	ANXIETFA	.104[a]	1.638	.103	.105	1.000
	DOMINAFA	.056[a]	.698	.486	.045	.629
	SOCINTFA	-.059[a]	-.785	.433	-.051	.731

a. Predictors in the Model: (Constant), EXTROFA

b. Dependent Variable: EASE

Mobile Telephone Social Interaction

Descriptive Statistics[a]

	Mean	Std. Deviation	N
SOCINTER	3.7789	1.4243	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EXTROFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: SOCINTER

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R NTILES of TYPE = 4.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.205[a]	.042	.038	1.3971	.042	10.487	1	240	.001
2	.265[b]	.070	.063	1.3790	.029	7.330	1	239	.007

a. Predictors: (Constant), EXTROFA

b. Predictors: (Constant), EXTROFA, ANXIETFA

ANOVA[c,d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	20.469	1	20.469	10.487	.001[a]
	Residual	468.453	240	1.952		
	Total	488.923	241			
2	Regression	34.409	2	17.204	9.047	.000[b]
	Residual	454.514	239	1.902		
	Total	488.923	241			

a. Predictors: (Constant), EXTROFA

b. Predictors: (Constant), EXTROFA, ANXIETFA

c. Dependent Variable: SOCINTER

d. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	5.154	.434		11.877	.000
	EXTROFA	-.914	.282	-.205	-3.238	.001
2	(Constant)	3.827	.651		5.878	.000
	EXTROFA	-.907	.279	-.203	-3.254	.001
	ANXIETFA	.841	.311	.169	2.707	.007

a. Dependent Variable: SOCINTER

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[c]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.047[a]	-.734	.464	-.047	.996
	NOVSEFA	-.131[a]	-1.999	.047	-.128	.912
	EMPATHFA	-.048[a]	-.727	.468	-.047	.929
	ANXIETFA	.169[a]	2.707	.007	.173	1.000
	DOMINAFA	-.056[a]	-.702	.484	-.045	.629
	SOCINTFA	-.072[a]	-.981	.328	-.063	.731
2	TOLERAFA	-.005[b]	-.078	.938	-.005	.936
	NOVSEFA	-.092[b]	-1.359	.176	-.088	.851
	EMPATHFA	-.056[b]	-.861	.390	-.056	.927
	DOMINAFA	-.036[b]	-.455	.649	-.030	.624
	SOCINTFA	-.061[b]	-.838	.403	-.054	.729

a. Predictors in the Model: (Constant), EXTROFA

b. Predictors in the Model: (Constant), EXTROFA, ANXIETFA

c. Dependent Variable: SOCINTER

Mobile Telephone Attitude

Descriptive Statistics[a]

	Mean	Std. Deviation	N
ATTITUDE	5.2748	1.2851	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EXTROFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	TOLERAFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: ATTITUDE

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	NTILES of TYPE = 4.00 (Selected)				R Square Change	F Change	df1	df2	Sig. F Change
1	.222[a]	.049	.045	1.2557	.049	12.405	1	240	.001
2	.261[b]	.068	.060	1.2458	.019	4.829	1	239	.029

a. Predictors: (Constant), EXTROFA

b. Predictors: (Constant), EXTROFA, TOLERAFA

ANOVA[c,d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.559	1	19.559	12.405	.001[a]
	Residual	378.417	240	1.577		
	Total	397.976	241			
2	Regression	27.054	2	13.527	8.716	.000[b]
	Residual	370.923	239	1.552		
	Total	397.976	241			

a. Predictors: (Constant), EXTROFA

b. Predictors: (Constant), EXTROFA, TOLERAFA

c. Dependent Variable: ATTITUDE

d. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	6.619	.390		16.971	.000
	EXTROFA	-.894	.254	-.222	-3.522	.001
2	(Constant)	7.299	.496		14.730	.000
	EXTROFA	-.861	.252	-.214	-3.414	.001
	TOLERAFA	-.551	.251	-.137	-2.198	.029

a. Dependent Variable: ATTITUDE

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[c]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	TOLERAFA	-.137[a]	-2.198	.029	-.141	.996
	NOVSEFA	-.052[a]	-.784	.434	-.051	.912
	EMPATHFA	-.073[a]	-1.122	.263	-.072	.929
	ANXIETFA	-.005[a]	-.073	.942	-.005	1.000
	DOMINAFA	-.120[a]	-1.514	.131	-.097	.629
	SOCINTFA	.086[a]	1.172	.243	.076	.731
2	NOVSEFA	-.026[b]	-.398	.691	-.026	.882
	EMPATHFA	-.025[b]	-.353	.724	-.023	.806
	ANXIETFA	-.041[b]	-.635	.526	-.041	.939
	DOMINAFA	-.115[b]	-1.461	.145	-.094	.629
	SOCINTFA	.115[b]	1.564	.119	.101	.712

a. Predictors in the Model: (Constant), EXTROFA

b. Predictors in the Model: (Constant), EXTROFA, TOLERAFA

c. Dependent Variable: ATTITUDE

Mobile Telephone Intention

Descriptive Statistics[a]

	Mean	Std. Deviation	N
INTENT	4.5186	1.8346	242
TOLERAFA	1.3237	.3205	242
NOVSEFA	1.1921	.2847	242
EMPATHFA	1.1760	.2202	242
ANXIETFA	1.5640	.2858	242
DOMINAFA	1.3595	.3452	242
EXTROFA	1.50351	.31874	242
SOCINTFA	1.2683	.2752	242

a. Selecting only cases for which NTILES of TYPE = 4.00

Variables Entered/Removed[a,b]

Model	Variables Entered	Variables Removed	Method
1	EMPATHFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	ANXIETFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	DOMINAFA	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: INTENT

b. Models are based only on cases for which NTILES of TYPE = 4.00

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	NTILES of TYPE = 4.00 (Selected)				R Square Change	F Change	df1	df2	Sig. F Change
1	.329[a]	.108	.105	1.7360	.108	29.167	1	240	.000
2	.363[b]	.132	.125	1.7163	.024	6.530	1	239	.011
3	.394[c]	.155	.145	1.6967	.023	6.556	1	238	.011

a. Predictors: (Constant), EMPATHFA

b. Predictors: (Constant), EMPATHFA, ANXIETFA

c. Predictors: (Constant), EMPATHFA, ANXIETFA, DOMINAFA

ANOVA[d,e]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	87.897	1	87.897	29.167	.000[a]
	Residual	723.269	240	3.014		
	Total	811.166	241			
2	Regression	107.133	2	53.567	18.184	.000[b]
	Residual	704.033	239	2.946		
	Total	811.166	241			
3	Regression	126.008	3	42.003	14.590	.000[c]
	Residual	685.158	238	2.879		
	Total	811.166	241			

a. Predictors: (Constant), EMPATHFA

b. Predictors: (Constant), EMPATHFA, ANXIETFA

c. Predictors: (Constant), EMPATHFA, ANXIETFA, DOMINAFA

d. Dependent Variable: INTENT

e. Selecting only cases for which NTILES of TYPE = 4.00

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.744	.608		12.745	.000
	EMPATHFA	-2.743	.508	-.329	-5.401	.000
2	(Constant)	9.229	.836		11.042	.000
	EMPATHFA	-2.690	.503	-.323	-5.352	.000
	ANXIETFA	-.989	.387	-.154	-2.555	.011
3	(Constant)	10.374	.939		11.043	.000
	EMPATHFA	-2.611	.498	-.313	-5.245	.000
	ANXIETFA	-1.072	.384	-.167	-2.791	.006
	DOMINAFA	-.815	.318	-.153	-2.561	.011

a. Dependent Variable: INTENT

b. Selecting only cases for which NTILES of TYPE = 4.00

Excluded Variables[d]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	TOLERAFA	.039[a]	.589	.557	.038	.865
	NOVSEFA	-.036[a]	-.591	.555	-.038	.983
	ANXIETFA	-.154[a]	-2.555	.011	-.163	.998
	DOMINAFA	-.139[a]	-2.302	.022	-.147	.997
	EXTROFA	-.099[a]	-1.563	.119	-.101	.929
	SOCINTFA	-.042[a]	-.654	.514	-.042	.899
2	TOLERAFA	-.009[b]	-.130	.897	-.008	.797
	NOVSEFA	-.082[b]	-1.307	.192	-.084	.917
	DOMINAFA	-.153[b]	-2.561	.011	-.164	.990
	EXTROFA	-.102[b]	-1.637	.103	-.106	.929
	SOCINTFA	-.054[b]	-.847	.398	-.055	.894
3	TOLERAFA	-.006[c]	-.085	.933	-.005	.796
	NOVSEFA	-.040[c]	-.616	.539	-.040	.843
	EXTROFA	-.007[c]	-.090	.929	-.006	.575
	SOCINTFA	-.015[c]	-.235	.815	-.015	.840

a. Predictors in the Model: (Constant), EMPATHFA

b. Predictors in the Model: (Constant), EMPATHFA, ANXIETFA

c. Predictors in the Model: (Constant), EMPATHFA, ANXIETFA, DOMINAFA

d. Dependent Variable: INTENT

Reliability Coefficient Outputs

Reliability extroversion

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
OPEN1	5.8103	1.5643	.3729	.5898
EXTRO2	5.9309	1.4428	.4886	.5280
EXTRO3	5.8741	1.4779	.4481	.5500
SOCINT3	6.1826	1.7090	.3977	.5816
EXTRO1	5.6986	1.7456	.2491	.6466

Reliability Coefficients

N of Cases = 568.0 N of Items = 5

Alpha = **.6350**

Reliability tolerance

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
EMP2	4.1813	1.2845	.2634	.6626
TOL1	3.9665	.9319	.5085	.5030
TOL2	3.9489	.8845	.5648	.4562
TOL3	3.9437	1.0444	.3582	.6176

Reliability Coefficients

N of Cases = 568.0 N of Items = 4

Alpha = **.6399**

Reliability novseek

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted

NOVS1	2.3961	.3631	.4790	.3984
NOVS2	2.2940	.3314	.4110	.5365
NOVS3	2.5282	.5318	.4048	.5554

Reliability Coefficients

N of Cases = 568.0 N of Items = 3

Alpha = **.6036**

Reliability empathy

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
EMP2	3.5697	.4965	.2640	.2976
EMP3	3.6490	.5815	.2648	.3195
COOP1	3.6455	.6003	.2067	.3636
OPEN2	3.3369	.4005	.2121	.3930

Reliability Coefficients

N of Cases = 568.0 N of Items = 4

Alpha = **.4084**

Reliability anxiety

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
EMP1	4.9104	.9585	.1951	.4459
ANX2	4.7135	.8069	.4015	.2304
ANX3	4.5888	.9785	.2609	.3823
OPEN3	4.7944	.9594	.1886	.4529

Reliability Coefficients

N of Cases = 568.0 N of Items = 4

Alpha = **.4539**

Reliability dominance

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
EXTRO2	2.7087	.6517	.3230	.6204
DOM2	2.8721	.6420	.4299	.4665
DOM3	2.7389	.5634	.4744	.3905

Reliability Coefficients

N of Cases = 568.0 N of Items = 3

Alpha = **.5976**

Reliability Social Interaction

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
SOCINT1	3.7616	.7309	.3348	.4302
COOP2	4.1032	.9697	.3097	.4657
COOP3	3.7972	.6825	.4144	.3445
SOCINT2	3.9893	.9161	.2146	.5281

Reliability Coefficients

N of Cases = 568.0 N of Items = 4

Alpha = **.5218**

Reliability Full Scale

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
SOCINT1	36.1096	12.0438	.4059	.5975
COOP2	36.4481	12.9337	.2895	.6161
COOP3	36.1365	12.2414	.3493	.6044
SOCINT2	36.3327	13.0355	.1592	.6255
NOVS1	36.3481	12.7283	.2730	.6148

NOVS2	36.2346	12.5460	.2793	.6129
NOVS3	36.4769	13.0438	.2854	.6178
EMP1	36.1442	12.7402	.2020	.6213
EMP2	36.3923	12.9441	.2261	.6197
EMP3	36.4712	13.1360	.2294	.6212
EXTRO1	35.8865	12.7251	.2245	.6189
ANX1	36.0885	14.9478	-.3887	.6836
ANX2	35.9404	13.9560	-.1368	.6572
ANX3	35.8269	14.6058	-.3273	.6714
COOP1	36.4769	13.2288	.1921	.6237
OPEN1	35.9962	12.1117	.3873	.5998
TOL1	36.1712	12.8242	.1810	.6237
TOL2	36.1558	12.8061	.1842	.6233
TOL3	36.1538	12.9397	.1453	.6277
OPEN2	36.1654	12.2462	.3531	.6041
EXTRO2	36.1077	11.8843	.4549	.5916
EXTRO3	36.0577	12.2125	.3524	.6038
DOM1	35.7000	13.5900	-.0054	.6380
DOM2	36.2635	12.4218	.3297	.6078
DOM3	36.1269	12.5234	.2637	.6143
SOCINT3	36.3635	12.2087	.4763	.5959
OPEN3	36.0250	13.1381	.0852	.6345

Reliability Coefficients

N of Cases = 568.0 N of Items = 27

Alpha = **.6311**

Principle Components Analysis Individual Differences questionnaire

Communalities

	Initial	Extraction
NOVS1	1.000	.611
NOVS2	1.000	.526
NOVS3	1.000	.522
EMP1	1.000	.530
EMP2	1.000	.446
EMP3	1.000	.484
EXTRO1	1.000	.338
ANX1	1.000	.493
ANX2	1.000	.590
ANX3	1.000	.460
COOP1	1.000	.591
OPEN1	1.000	.483
TOL1	1.000	.599
TOL2	1.000	.661
TOL3	1.000	.445
SOCINT1	1.000	.470
OPEN2	1.000	.330
EXTRO2	1.000	.550
EXTRO3	1.000	.609
COOP2	1.000	.504
DOM1	1.000	.325
COOP3	1.000	.564
DOM2	1.000	.633
DOM3	1.000	.671
SOCINT2	1.000	.392
SOCINT3	1.000	.442
OPEN3	1.000	.243

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.501	16.672	16.672	4.501	16.672	16.672	2.418	8.954	8.954
2	2.380	8.817	25.489	2.380	8.817	25.489	2.262	8.378	17.332
3	1.970	7.296	32.785	1.970	7.296	32.785	2.044	7.572	24.904
4	1.264	4.680	37.464	1.264	4.680	37.464	1.839	6.811	31.714
5	1.204	4.459	41.924	1.204	4.459	41.924	1.737	6.433	38.148
6	1.154	4.272	46.196	1.154	4.272	46.196	1.664	6.164	44.312
7	1.038	3.846	50.042	1.038	3.846	50.042	1.547	5.729	50.042
8	.967	3.580	53.622						
9	.945	3.500	57.122						
10	.922	3.414	60.536						
11	.885	3.278	63.814						
12	.841	3.115	66.928						
13	.818	3.031	69.959						
14	.770	2.852	72.812						
15	.742	2.750	75.562						
16	.721	2.670	78.231						
17	.697	2.583	80.814						
18	.662	2.452	83.267						
19	.628	2.325	85.592						
20	.614	2.276	87.868						
21	.556	2.060	89.928						
22	.537	1.988	91.916						
23	.494	1.830	93.746						
24	.479	1.775	95.521						
25	.433	1.605	97.126						
26	.416	1.540	98.666						
27	.360	1.334	100.000						

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
NOVS1	.464		-.442	.328			
NOVS2	.463					-.350	
NOVS3	.461			.429			
EMP1			.399		.397		.317
EMP2			.458				
EMP3			.356	.445			
EXTRO1		.413					
ANX1	-.523			.370			
ANX2	-.369	.379	.374				
ANX3	-.526	.355					
COOP1							-.597
OPEN1	.489		.320				
TOL1	.421	-.620					
TOL2	.359	-.632					
TOL3		-.407			.435		
SOCINT1	.509						
OPEN2	.428						
EXTRO2	.565					.317	
EXTRO3	.562			-.356			
COOP2	.415		.306		-.412		
DOM1		.464					
COOP3	.463		.391				.346
DOM2	.429	.333				.341	
DOM3	.362	.328	-.408			.456	
SOCINT2				-.323			.312
SOCINT3	.616						
OPEN3			.377				

Extraction Method: Principal Component Analysis.

a. 7 components extracted.

Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
NOVS1			.735				
NOVS2			.692				
NOVS3			.644				
EMP1						.694	
EMP2		.461			.361		
EMP3					.635		
EXTRO1	.481						
ANX1	-.594						
ANX2						.656	
ANX3		-.360		-.353		.302	
COOP1					.698		
OPEN1	.541						
TOL1		.701					
TOL2		.802					
TOL3		.626					
SOCINT1	.305			.433			
OPEN2					.383		
EXTRO2	.623						.310
EXTRO3	.689						
COOP2				.463	.427		
DOM1		-.368					
COOP3				.679			
DOM2							.728
DOM3							.740
SOCINT2				.592			
SOCINT3	.389		.387				
OPEN3						.446	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 12 iterations.

Component Transformation Matrix

Component	1	2	3	4	5	6	7
1	.557	.347	.466	.427	.316	-.052	.259
2	.411	-.753	.033	.010	-.120	.413	.278
3	-.056	.078	-.398	.310	.537	.591	-.316
4	-.494	-.059	.533	-.352	.427	.275	.295
5	.323	.437	.151	-.490	-.343	.524	-.223
6	.148	.248	-.562	-.335	.192	-.038	.670
7	-.384	.225	-.005	.495	-.511	.355	.412

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

APPENDIX E

ON-SCREEN STATEMENTS, QUESTIONNAIRE AND ANOVA OUTPUT FOR THE FIRST STUDY REPORTED IN CHAPTER 9

On-screen statements

Participant No.__________ Condition:_____________

Age:____________ Sex: Male/Female

Please respond to the following statements using a rating scale from 1 to 7 of how strongly you agree or disagree with each statement (1 being very likely or I agree with this statement and 7 being very unlikely or I disagree with this statement). When I use this screen other people can see what I'm doing.

Other people would be able to see my personal information on this screen.	1	2	3	4	5	6	7
When using this screen the only time I believe I would have enough privacy is when no one else is around.	1	2	3	4	5	6	7
I would feel uncomfortable using this screen if there was someone queuing behind me.	1	2	3	4	5	6	7
My privacy would be at risk using this screen.	1	2	3	4	5	6	7
This screen is just the right size for dealing with personal information.	1	2	3	4	5	6	7
This screen size makes use easier.	1	2	3	4	5	6	7
This screen size enables me to complete my task quickly.	1	2	3	4	5	6	7
This screen size makes the information clear and precise.	1	2	3	4	5	6	7
I do not feel comfortable with this screen size.	1	2	3	4	5	6	7
All things considered I do not like this screen.	1	2	3	4	5	6	7
All things considered, I find this screen pleasant.	1	2	3	4	5	6	7

Questionnaire –privacy, clarity of on screen information and attitude

Participant No. …………..

Sex: Male …….. Female…………..

Age:…………

Occupation:……………………………………..

Please state the location of the ATM you use most often:
………………………………………………………………….

On average how many times do you use this ATM per month?
…………………

Please read and respond to all of the statements using the following word pairs. Please place a cross at the point between them which describes the ATM you use most frequent:

I believe the level of privacy at the ATM I use most often is:

Good								Bad
Sufficient								Insufficient
Public								Private
Comfortable								Uncomfortable

I believe the level of personal space at the ATM I use most often is:

Good								Bad
Sufficient								Insufficient
Pleasant								Unpleasant
Comfortable								Uncomfortable

Using an ATM is:

Simple								Complex
Easy								Difficult
Fast								Slow
Laborious								Effortless

I believe ATMs are:

Useful									Useless
Essential									Trivial
Important									Unimportant
Indispensable									Dispensable

I believe information on an ATM screen appears:

Perfect									Imperfect
Large									Small
Bright									Dark
Clear									Obscure

On a scale from 1 to 7 please rate how important it is for other people <u>not</u> to see the following information on an ATM screen (1 – very important to 7 very unimportant. Even if the statement does not apply to you please respond to all:

Your name:	V.Imp	1	2	3	4	5	6	7	V.Unimp.
Your address:	V.Imp	1	2	3	4	5	6	7	V.Unimp.
Your account No.	V.Imp	1	2	3	4	5	6	7	V.Unimp.
Your account balance.	V.Imp	1	2	3	4	5	6	7	V.Unimp.
The amount of money you have borrowed.	V.Imp	1	2	3	4	5	6	7	V.Unimp.
The amount outstanding on your mortgage.	V.Imp	1	2	3	4	5	6	7	V.Unimp.
Your salary.	V.Imp	1	2	3	4	5	6	7	V.Unimp.
The amount you are overdrawn.	V.Imp	1	2	3	4	5	6	7	V.Unimp.
How much money you spend each month.	V.Imp	1	2	3	4	5	6	7	V.Unimp.
What you spend your money on.	V.Imp	1	2	3	4	5	6	7	V.Unimp.

Anova privacy screen

Within-Subjects Factors

Measure: MEASURE_1

WING	SCREE	Dependent Variable
1	1	MS1P
	2	MS2P
	3	MS3P
2	1	MS4P
	2	MS5P
	3	MS6P

Descriptive Statistics

	Mean	Std. Deviation	N
MS1P	3.3533	1.5326	60
MS2P	2.1333	1.0445	60
MS3P	1.7167	1.0279	60
MS4P	3.9567	1.5479	60
MS5P	2.7933	1.1869	60
MS6P	2.0800	1.2186	60

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
WING	Pillai's Trace	.362	33.487[a]	1.000	59.000	.000
	Wilks' Lambda	.638	33.487[a]	1.000	59.000	.000
	Hotelling's Trace	.568	33.487[a]	1.000	59.000	.000
	Roy's Largest Root	.568	33.487[a]	1.000	59.000	.000
SCREE	Pillai's Trace	.628	48.908[a]	2.000	58.000	.000
	Wilks' Lambda	.372	48.908[a]	2.000	58.000	.000
	Hotelling's Trace	1.686	48.908[a]	2.000	58.000	.000
	Roy's Largest Root	1.686	48.908[a]	2.000	58.000	.000
WING * SCREE	Pillai's Trace	.057	1.750[a]	2.000	58.000	.183
	Wilks' Lambda	.943	1.750[a]	2.000	58.000	.183
	Hotelling's Trace	.060	1.750[a]	2.000	58.000	.183
	Roy's Largest Root	.060	1.750[a]	2.000	58.000	.183

a. Exact statistic

b.

Design: Intercept
Within Subjects Design: WING+SCREE+WING*SCREE

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
WING	Sphericity Assumed	26.460	1	26.460	33.487	.000
	Greenhouse-Geisser	26.460	1.000	26.460	33.487	.000
	Huynh-Feldt	26.460	1.000	26.460	33.487	.000
	Lower-bound	26.460	1.000	26.460	33.487	.000
Error(WING)	Sphericity Assumed	46.620	59	.790		
	Greenhouse-Geisser	46.620	59.000	.790		
	Huynh-Feldt	46.620	59.000	.790		
	Lower-bound	46.620	59.000	.790		
SCREE	Sphericity Assumed	193.007	2	96.503	79.703	.000
	Greenhouse-Geisser	193.007	1.433	134.690	79.703	.000
	Huynh-Feldt	193.007	1.459	132.306	79.703	.000
	Lower-bound	193.007	1.000	193.007	79.703	.000
Error(SCREE)	Sphericity Assumed	142.873	118	1.211		
	Greenhouse-Geisser	142.873	84.546	1.690		
	Huynh-Feldt	142.873	86.069	1.660		
	Lower-bound	142.873	59.000	2.422		
WING * SCREE	Sphericity Assumed	1.488	2	.744	1.663	.194
	Greenhouse-Geisser	1.488	1.824	.816	1.663	.197
	Huynh-Feldt	1.488	1.879	.792	1.663	.196
	Lower-bound	1.488	1.000	1.488	1.663	.202
Error(WING*SCREE)	Sphericity Assumed	52.792	118	.447		
	Greenhouse-Geisser	52.792	107.631	.490		
	Huynh-Feldt	52.792	110.884	.476		
	Lower-bound	52.792	59.000	.895		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	WING	SCREE	Type III Sum of Squares	df	Mean Square	F	Sig.
WING	Linear		26.460	1	26.460	33.487	.000
Error(WING)	Linear		46.620	59	.790		
SCREE		Linear	185.153	1	185.153	99.483	.000
		Quadratic	7.854	1	7.854	14.014	.000
Error(SCREE)		Linear	109.807	59	1.861		
		Quadratic	33.066	59	.560		
WING * SCREE	Linear	Linear	.864	1	.864	1.474	.230
		Quadratic	.624	1	.624	2.022	.160
Error(WING*SCREE)	Linear	Linear	34.576	59	.586		
		Quadratic	18.216	59	.309		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	2570.678	1	2570.678	452.581	.000
Error	335.122	59	5.680		

Anova clarity of on-screen information

Within-Subjects Factors

Measure: MEASURE_1

WING	SCREE	Dependent Variable
1	1	MS1S
	2	MS2S
	3	MS3S
2	1	MS4S
	2	MS5S
	3	MS6S

Descriptive Statistics

	Mean	Std. Deviation	N
MS1S	3.5133	.9326	60
MS2S	3.2700	.9989	60
MS3S	3.7367	1.3279	60
MS4S	3.9033	1.0618	60
MS5S	3.3233	.9316	60
MS6S	3.3933	1.1379	60

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
WING	Pillai's Trace	.003	.196[a]	1.000	59.000	.660
	Wilks' Lambda	.997	.196[a]	1.000	59.000	.660
	Hotelling's Trace	.003	.196[a]	1.000	59.000	.660
	Roy's Largest Root	.003	.196[a]	1.000	59.000	.660
SCREE	Pillai's Trace	.277	11.133[a]	2.000	58.000	.000
	Wilks' Lambda	.723	11.133[a]	2.000	58.000	.000
	Hotelling's Trace	.384	11.133[a]	2.000	58.000	.000
	Roy's Largest Root	.384	11.133[a]	2.000	58.000	.000
WING * SCREE	Pillai's Trace	.241	9.226[a]	2.000	58.000	.000
	Wilks' Lambda	.759	9.226[a]	2.000	58.000	.000
	Hotelling's Trace	.318	9.226[a]	2.000	58.000	.000
	Roy's Largest Root	.318	9.226[a]	2.000	58.000	.000

a. Exact statistic

b.

Design: Intercept

Within Subjects Design: WING+SCREE+WING*SCREE

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
WING	Sphericity Assumed	1.000E-01	1	1.000E-01	.196	.660
	Greenhouse-Geisser	1.000E-01	1.000	1.000E-01	.196	.660
	Huynh-Feldt	1.000E-01	1.000	1.000E-01	.196	.660
	Lower-bound	1.000E-01	1.000	1.000E-01	.196	.660
Error(WING)	Sphericity Assumed	30.167	59	.511		
	Greenhouse-Geisser	30.167	59.000	.511		
	Huynh-Feldt	30.167	59.000	.511		
	Lower-bound	30.167	59.000	.511		
SCREE	Sphericity Assumed	10.481	2	5.240	5.436	.006
	Greenhouse-Geisser	10.481	1.483	7.069	5.436	.012
	Huynh-Feldt	10.481	1.512	6.933	5.436	.011
	Lower-bound	10.481	1.000	10.481	5.436	.023
Error(SCREE)	Sphericity Assumed	113.759	118	.964		
	Greenhouse-Geisser	113.759	87.472	1.301		
	Huynh-Feldt	113.759	89.196	1.275		
	Lower-bound	113.759	59.000	1.928		
WING * SCREE	Sphericity Assumed	8.085	2	4.042	9.515	.000
	Greenhouse-Geisser	8.085	1.999	4.045	9.515	.000
	Huynh-Feldt	8.085	2.000	4.042	9.515	.000
	Lower-bound	8.085	1.000	8.085	9.515	.003
Error(WING*SCREE)	Sphericity Assumed	50.129	118	.425		
	Greenhouse-Geisser	50.129	117.929	.425		
	Huynh-Feldt	50.129	118.000	.425		
	Lower-bound	50.129	59.000	.850		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	WING	SCREE	Type III Sum of Squares	df	Mean Square	F	Sig.
WING	Linear		1.000E-01	1	1.000E-01	.196	.660
Error(WING)	Linear		30.167	59	.511		
SCREE		Linear	1.233	1	1.233	.811	.371
		Quadratic	9.248	1	9.248	22.629	.000
Error(SCREE)		Linear	89.647	59	1.519		
		Quadratic	24.112	59	.409		
WING * SCREE	Linear	Linear	8.067	1	8.067	18.757	.000
		Quadratic	1.800E-02	1	1.800E-02	.043	.837
Error(WING*SCREE)	Linear	Linear	25.373	59	.430		
		Quadratic	24.755	59	.420		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	4468.996	1	4468.996	1230.473	.000
Error	214.284	59	3.632		

ANOVA attitude screen

Within-Subjects Factors

Measure: MEASURE_1

WING	SCREE	Dependent Variable
1	1	MS1A
	2	MS2A
	3	MS3A
2	1	MS4A
	2	MS5A
	3	MS6A

Descriptive Statistics

	Mean	Std. Deviation	N
MS1A	3.6750	.8578	60
MS2A	3.5750	.9603	60
MS3A	3.7000	1.0464	60
MS4A	3.9583	.8402	60
MS5A	3.8083	.9024	60
MS6A	3.8083	1.1050	60

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
WING	Pillai's Trace	.126	8.467[a]	1.000	59.000	.005
	Wilks' Lambda	.874	8.467[a]	1.000	59.000	.005
	Hotelling's Trace	.144	8.467[a]	1.000	59.000	.005
	Roy's Largest Root	.144	8.467[a]	1.000	59.000	.005
SCREE	Pillai's Trace	.025	.742[a]	2.000	58.000	.481
	Wilks' Lambda	.975	.742[a]	2.000	58.000	.481
	Hotelling's Trace	.026	.742[a]	2.000	58.000	.481
	Roy's Largest Root	.026	.742[a]	2.000	58.000	.481
WING * SCREE	Pillai's Trace	.011	.322[a]	2.000	58.000	.726
	Wilks' Lambda	.989	.322[a]	2.000	58.000	.726
	Hotelling's Trace	.011	.322[a]	2.000	58.000	.726
	Roy's Largest Root	.011	.322[a]	2.000	58.000	.726

a. Exact statistic

b.

Design: Intercept
Within Subjects Design: WING+SCREE+WING*SCREE

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
WING	Sphericity Assumed	3.906	1	3.906	8.467	.005
	Greenhouse-Geisser	3.906	1.000	3.906	8.467	.005
	Huynh-Feldt	3.906	1.000	3.906	8.467	.005
	Lower-bound	3.906	1.000	3.906	8.467	.005
Error(WING)	Sphericity Assumed	27.219	59	.461		
	Greenhouse-Geisser	27.219	59.000	.461		
	Huynh-Feldt	27.219	59.000	.461		
	Lower-bound	27.219	59.000	.461		
SCREE	Sphericity Assumed	.937	2	.469	.566	.569
	Greenhouse-Geisser	.937	1.865	.503	.566	.558
	Huynh-Feldt	.937	1.923	.487	.566	.563
	Lower-bound	.937	1.000	.937	.566	.455
Error(SCREE)	Sphericity Assumed	97.729	118	.828		
	Greenhouse-Geisser	97.729	110.034	.888		
	Huynh-Feldt	97.729	113.486	.861		
	Lower-bound	97.729	59.000	1.656		
WING * SCREE	Sphericity Assumed	.487	2	.244	.349	.706
	Greenhouse-Geisser	.487	1.961	.249	.349	.702
	Huynh-Feldt	.487	2.000	.244	.349	.706
	Lower-bound	.487	1.000	.487	.349	.557
Error(WING*SCREE)	Sphericity Assumed	82.513	118	.699		
	Greenhouse-Geisser	82.513	115.714	.713		
	Huynh-Feldt	82.513	118.000	.699		
	Lower-bound	82.513	59.000	1.399		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	WING	SCREE	Type III Sum of Squares	df	Mean Square	F	Sig.
WING	Linear		3.906	1	3.906	8.467	.005
Error(WING)	Linear		27.219	59	.461		
SCREE		Linear	.234	1	.234	.230	.633
		Quadratic	.703	1	.703	1.102	.298
Error(SCREE)		Linear	60.078	59	1.018		
		Quadratic	37.651	59	.638		
WING * SCREE	Linear	Linear	.459	1	.459	.648	.424
		Quadratic	2.813E-02	1	2.813E-02	.041	.841
Error(WING*SCREE)	Linear	Linear	41.853	59	.709		
		Quadratic	40.659	59	.689		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	5073.756	1	5073.756	2565.092	.000
Error	116.702	59	1.978		

APPENDIX F

QUESTIONNAIRE CHAPTER 9

Social Density & Technology Study – information for participants

Thank you for participating in this study – your help is appreciated.

Please allocate yourself an identification number from the list provided. It is very important that you remember this number and do not reveal it to anyone. You will need this ID number to access the program that will be used in this study and it will help in keeping the information provided by you confidential.

I would be grateful if you would complete the attached questionnaire. The questions are of a personal nature and you must answer these truthfully, this is an important part of the research. Ignore any question that does not apply to you but please try to complete all of them. I would be grateful if you would rate each question on a scale of 1 to 5 how personal you think each question is, with one being not at all personal to 5 being very personal. Once you have completed the questionnaire please place it in the envelope provided and seal it. The sealed envelope will be passed to a third person who will enter the information you have provided into a computer program which will only be accessible when your personal ID number is entered.

All participants will be randomly allocated to one of four groups. At the beginning of each experimental trial each participant in the groups will enter their personal ID number into the pc or personal digital assistant (PDA) and will be presented with six statements. These statements used will relate to the questions previously answered by participants e.g. your mobile telephone number is: There will be a short delay before the program reveals the response actually given by that particular participant. As the program is designed to randomly generate statements from the questionnaire but only reveal that participants response certain statements may not apply. However an important part of the research is that when participants are confronted with each statement they act as if they all apply to them so all of the other participants in the room do not know what statements are true and which are false. Throughout the process all participants must not reveal to others whether the statements that appeared on the screen were actually true or false. While each participant is confronted with the statements other participants will be trying to access this, there will be an incentive in the study for the participant who accesses the most information.

Each participant who is confronted with the on-screen information will have their heart rate and galvanic skin response will be measured. This will be taken by a heart rate monitored and a recording will be taken of galvanic skin response (GSR). These will be measured using devices attached to your fingers.

Whilst each participant is viewing the on-screen information other participants will be instructed that an incentive will be given at the end of the trial for the one who has recorded the most information they have seen on-screen. However the other participants must not touch or intentionally invade the other participant's personal space.

After participant one has been presented with all six statements and possible answers they will rejoin the group and the next participant will follow the same procedure. This procedure will be followed until all participants in each group has accessed information on either a pc of PDA dependent on the condition they were allocated to.

Participants can withdraw from the experiment at anytime and the information they have submitted will be destroyed.

After the experiment has finished all information supplied by all participants will be destroyed. Due to participant confidentiality no individual feedback will be given.

The results of the study will be available around July 2004. If you would like a copy of the results please e-mail l.little@unn.ac.uk

If you have any problems or concerns about participating in this study please don't hesitate in contacting me.

I agree to take part in this study. I have read the instructions and fully understand the nature of the research. I agree to the personal information from the questionnaire being inputted into a computer program. I am aware that only I will be able to access this information by entering a personal four-digit number. I understand all personal information that has been recorded during the study will be destroyed at the end and no record of any information will be retained.

NAME:______________________________________

SIGNATURE;__________________________________

DATE:____________________________________

Confederate Rating Sheet

Participant No._________ Condition:___________

Sex: Male/Female

How anxious did the participant appear to be?

Very anxious 1 2 3 4 5 6 7 Not at all anxious

How much on-screen information did you see?

....

Did the participant make any changes in behaviour? Please describe.

....

Questionnaire – Technology Study

Personal ID number.......................
Please answer the following questions truthfully.

1. What is your home telephone number?...
2. What is your main bank account number?...
3. How many sexual partners have you had?..
4. What is your current bank balance?..
5. What is your true weight?...
6. What is your mobile telephone number?..
7. How much are you in debt?...
8. What is your home address?..
   ....
9. State your most embarrassing moment?..
   ....
   ....
10. Have you ever been tested for a sexually transmitted disease? YES/NO
11. Name a person from university or work who you dislike.
    ....
12. Name a person from university or work who you find sexually attractive.
    ....
13. How many times have you taken illegal drugs?....................................
14. In the past year what is the biggest lie you have told?.............................
    ....
15. What is the gross income of your family?..
16. What is your salary?...
17. How much are you overdrawn in your current account?...........................
18. What do you spend the most money on each month?..............................
19. State an item or something you have stolen...
    ....
20. State something about yourself you would not like others to know.
    ....
    ....
    ....

Questionnaire – Pre-test Rating Personal Information

Male/Female Age:...............

Please rate on a scale of 1 –5 how personal you would rate each of the following questions or statements with **1** being **not at all personal** to **5** being **very personal.**

1.	What is your home telephone number?	1	2	3	4	5
2.	What is your main bank account number?	1	2	3	4	5
3.	How many sexual partners have you had?	1	2	3	4	5
4.	What is your current bank balance?	1	2	3	4	5
5.	What is your true weight?	1	2	3	4	5
6.	What is your mobile telephone number?	1	2	3	4	5
7.	How much are you in debt?	1	2	3	4	5
8.	What is your home address?	1	2	3	4	5
9.	State your most embarrassing moment?	1	2	3	4	5
10.	Have you ever been tested for from a sexually transmitted disease?	1	2	3	4	5
11.	Name a person from university or work who you dislike.	1	2	3	4	5
12.	Name a person from university or work who you find sexually attractive.	1	2	3	4	5
13.	How many times have you taken illegal drugs?	1	2	3	4	5
14.	In the past year what is the biggest lie you have told?	1	2	3	4	5
15.	What is the gross income of your family?	1	2	3	4	5
16.	What is your salary?	1	2	3	4	5
17.	How much are you overdrawn in your current account?	1	2	3	4	5
18.	What do you spend the most money on each month?	1	2	3	4	5

19.	State an item of something you have stolen.	1	2	3	4	5
20	State something about yourself you would not like others to know.	1	2	3	4	5

Questions used for rating device for privacy, clarity of on-screen information and attitude.

Participant No.__________ Condition:____________

Age:______________ Sex: Male/Female

Please respond to the following statements using a rating scale from 1 to 7 of how strongly you agree or disagree with each statement (1 being very likely or I agree with this statement and 7 being very unlikely or I disagree with this statement). When I use this screen other people can see what I'm doing.

Other people would be able to see my personal information on this screen.	1	2	3	4	5	6	7
When using this screen the only time I believe I would have enough privacy is when no one else is around.	1	2	3	4	5	6	7
I would feel uncomfortable using this screen if there was someone queuing behind me.	1	2	3	4	5	6	7
My privacy would be at risk using this screen.	1	2	3	4	5	6	7
This screen is just the right size for dealing with personal information.	1	2	3	4	5	6	7
This screen size makes use easier.	1	2	3	4	5	6	7
This screen size enables me to complete my task quickly.	1	2	3	4	5	6	7
This screen size makes the information clear and precise.	1	2	3	4	5	6	7
I do not feel comfortable with this screen size.	1	2	3	4	5	6	7
All things considered I do not like this screen.	1	2	3	4	5	6	7
All things considered, I find this screen pleasant.	1	2	3	4	5	6	7

Debrief

Thank you for taking part in this study. The aim of the study was to measure any changes in participants' levels of arousal while being presented with personal information on different technological devices. Also to determine if crowding has any effect on this.

I must inform you to make the study as realistic as possible deception has been used. You were led to believe the responses you gave on the initial questionnaire were inputted into the computer program. In fact this is untrue, none of your personal information has been used in any part of this study.

As you are aware all participants deposited their sealed envelopes into a locked box. When the envelope was deposited into the box it was removed unopened and shredded immediately.

Participants were informed other people in the room would be trying to see as much information as possible that appeared on screen. Again deception was used. The other people in the room except the actual participant were confederates of the experimenter. These people knew the true nature of the study and only record the amount of screen information visible and not what the information actually was. They also knew all the on screen information was false and not related to any participant in anyway.

Participants were also told the only way they could access their personal information was by using the four-digit ID number selected at the beginning of the study. In fact this was false, any four-digit number can be used to begin the program. None of your personal information from the questionnaire has been used in this study or in the development of the program. All responses that appeared on screen were false and randomly generated by the program.

Due to the nature of the study you cannot be identified in anyway, therefore no individual feedback can be given. You still have the right to withdraw your data if you wish to do so.

Once again thanks for taking part, your time and effort and greatly appreciated.

ANOVA for rating/response to questions

Between-Subjects Factors

		Value Label	N
CONDIT1	1.00	alone	34
	2.00	crodwed	34
CONDIT2	1.00	iPAC	34
	2.00	PC	34

Descriptive Statistics

	CONDIT1	CONDIT2	Mean	Std. Deviation	N
MEANRAT	alone	iPAC	3.3315	.3755	17
		PC	2.8690	.5238	17
		Total	3.1002	.5065	34
	crodwed	iPAC	3.0931	.5527	17
		PC	3.0941	.6408	17
		Total	3.0936	.5892	34
	Total	iPAC	3.2123	.4808	34
		PC	2.9815	.5875	34
		Total	3.0969	.5453	68
MEANRES	alone	iPAC	5.5438	1.5519	17
		PC	5.5842	.8732	17
		Total	5.5640	1.2401	34
	crodwed	iPAC	6.2333	2.3330	17
		PC	4.3669	.9180	17
		Total	5.3001	1.9862	34
	Total	iPAC	5.8886	1.9822	34
		PC	4.9756	1.0770	34
		Total	5.4321	1.6487	68

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.983	1771.988[a]	2.000	63.000	.000
	Wilks' Lambda	.017	1771.988[a]	2.000	63.000	.000
	Hotelling's Trace	56.254	1771.988[a]	2.000	63.000	.000
	Roy's Largest Root	56.254	1771.988[a]	2.000	63.000	.000
CONDIT1	Pillai's Trace	.008	.257[a]	2.000	63.000	.774
	Wilks' Lambda	.992	.257[a]	2.000	63.000	.774
	Hotelling's Trace	.008	.257[a]	2.000	63.000	.774
	Roy's Largest Root	.008	.257[a]	2.000	63.000	.774
CONDIT2	Pillai's Trace	.142	5.207[a]	2.000	63.000	.008
	Wilks' Lambda	.858	5.207[a]	2.000	63.000	.008
	Hotelling's Trace	.165	5.207[a]	2.000	63.000	.008
	Roy's Largest Root	.165	5.207[a]	2.000	63.000	.008
CONDIT1 * CONDIT2	Pillai's Trace	.119	4.271[a]	2.000	63.000	.018
	Wilks' Lambda	.881	4.271[a]	2.000	63.000	.018
	Hotelling's Trace	.136	4.271[a]	2.000	63.000	.018
	Roy's Largest Root	.136	4.271[a]	2.000	63.000	.018

a. Exact statistic

b. Design: Intercept+CONDIT1+CONDIT2+CONDIT1 * CONDIT2

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	MEANRAT	1.819[a]	3	.606	2.144	.103
	MEANRES	30.806[b]	3	10.269	4.343	.008
Intercept	MEANRAT	652.187	1	652.187	2305.623	.000
	MEANRES	2006.499	1	2006.499	848.697	.000
CONDIT1	MEANRAT	7.419E-04	1	7.419E-04	.003	.959
	MEANRES	1.184	1	1.184	.501	.482
CONDIT2	MEANRAT	.905	1	.905	3.201	.078
	MEANRES	14.171	1	14.171	5.994	.017
CONDIT1 * CONDIT2	MEANRAT	.913	1	.913	3.228	.077
	MEANRES	15.451	1	15.451	6.536	.013
Error	MEANRAT	18.104	64	.283		
	MEANRES	151.310	64	2.364		
Total	MEANRAT	672.109	68			
	MEANRES	2188.615	68			
Corrected Total	MEANRAT	19.923	67			
	MEANRES	182.116	67			

a. R Squared = .091 (Adjusted R Squared = .049)

b. R Squared = .169 (Adjusted R Squared = .130)

ANOVA HR alone/crowded iPAC/PC

Between-Subjects Factors

		Value Label	N
COND3	1.00	ipac	32
	2.00	pc	32
COND2	1.00	alone	32
	2.00	crowded	32

Descriptive Statistics

	COND3	COND2	Mean	Std. Deviation	N
BASEHR	ipac	alone	60.7111	15.2197	16
		crowded	71.3806	10.4308	16
		Total	66.0458	13.9323	32
	pc	alone	67.7066	19.4898	16
		crowded	68.2544	8.1853	16
		Total	67.9805	14.7070	32
	Total	alone	64.2088	17.5645	32
		crowded	69.8175	9.3588	32
		Total	67.0132	14.2441	64
HRMEAN	ipac	alone	84.6840	10.3270	16
		crowded	92.6127	14.5878	16
		Total	88.6483	13.0689	32
	pc	alone	95.9802	18.3212	16
		crowded	105.4762	21.1308	16
		Total	100.7282	20.0435	32
	Total	alone	90.3321	15.7147	32
		crowded	99.0444	19.0191	32
		Total	94.6883	17.8546	64

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.979	1372.078[a]	2.000	59.000	.000
	Wilks' Lambda	.021	1372.078[a]	2.000	59.000	.000
	Hotelling's Trace	46.511	1372.078[a]	2.000	59.000	.000
	Roy's Largest Root	46.511	1372.078[a]	2.000	59.000	.000
COND3	Pillai's Trace	.125	4.203[a]	2.000	59.000	.020
	Wilks' Lambda	.875	4.203[a]	2.000	59.000	.020
	Hotelling's Trace	.142	4.203[a]	2.000	59.000	.020
	Roy's Largest Root	.142	4.203[a]	2.000	59.000	.020
COND2	Pillai's Trace	.084	2.719[a]	2.000	59.000	.074
	Wilks' Lambda	.916	2.719[a]	2.000	59.000	.074
	Hotelling's Trace	.092	2.719[a]	2.000	59.000	.074
	Roy's Largest Root	.092	2.719[a]	2.000	59.000	.074
COND3 * COND2	Pillai's Trace	.039	1.209[a]	2.000	59.000	.306
	Wilks' Lambda	.961	1.209[a]	2.000	59.000	.306
	Hotelling's Trace	.041	1.209[a]	2.000	59.000	.306
	Roy's Largest Root	.041	1.209[a]	2.000	59.000	.306

a. Exact statistic

b. Design: Intercept+COND3+COND2+COND3 * COND2

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	BASEHR	973.002[a]	3	324.334	1.648	.188
	HRMEAN	3559.062[b]	3	1186.354	4.308	.008
Intercept	BASEHR	287408.839	1	287408.839	1460.237	.000
	HRMEAN	573815.561	1	573815.561	2083.519	.000
COND3	BASEHR	59.884	1	59.884	.304	.583
	HRMEAN	2334.760	1	2334.760	8.477	.005
COND2	BASEHR	503.318	1	503.318	2.557	.115
	HRMEAN	1214.477	1	1214.477	4.410	.040
COND3 * COND2	BASEHR	409.799	1	409.799	2.082	.154
	HRMEAN	9.825	1	9.825	.036	.851
Error	BASEHR	11809.402	60	196.823		
	HRMEAN	16524.414	60	275.407		
Total	BASEHR	300191.242	64			
	HRMEAN	593899.037	64			
Corrected Total	BASEHR	12782.403	63			
	HRMEAN	20083.476	63			

a. R Squared = .076 (Adjusted R Squared = .030)

b. R Squared = .177 (Adjusted R Squared = .136)

ANOVA rating questionnaire: privacy, clarity & attitude

Between-Subjects Factors

		Value Label	N
CONDITI1	1.00	alone	34
	2.00	crowded	34
CONDITI2	1.00	ipac	34
	2.00	pc	34

Descriptive Statistics

	CONDITI1	CONDITI2	Mean	Std. Deviation	N
PRIVACY	alone	ipac	5.1647	1.2026	17
		pc	3.0588	1.1040	17
		Total	4.1118	1.5603	34
	crowded	ipac	4.1294	1.5214	17
		pc	3.1765	1.5246	17
		Total	3.6529	1.5758	34
	Total	ipac	4.6471	1.4490	34
		pc	3.1176	1.3121	34
		Total	3.8824	1.5734	68
SCREEN	alone	ipac	5.3529	1.2156	17
		pc	5.1412	.6433	17
		Total	5.2471	.9637	34
	crowded	ipac	4.8824	1.3821	17
		pc	4.0471	1.4116	17
		Total	4.4647	1.4395	34
	Total	ipac	5.1176	1.3037	34
		pc	4.5941	1.2145	34
		Total	4.8559	1.2780	68
ATTITUDE	alone	ipac	5.8824	1.0388	17
		pc	4.9706	1.3633	17
		Total	5.4265	1.2800	34
	crowded	ipac	5.0588	1.9436	17
		pc	3.8824	1.2812	17
		Total	4.4706	1.7274	34
	Total	ipac	5.4706	1.5904	34
		pc	4.4265	1.4149	34
		Total	4.9485	1.5838	68

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.960	497.729[a]	3.000	62.000	.000
	Wilks' Lambda	.040	497.729[a]	3.000	62.000	.000
	Hotelling's Trace	24.084	497.729[a]	3.000	62.000	.000
	Roy's Largest Root	24.084	497.729[a]	3.000	62.000	.000
CONDITI1	Pillai's Trace	.131	3.108[a]	3.000	62.000	.033
	Wilks' Lambda	.869	3.108[a]	3.000	62.000	.033
	Hotelling's Trace	.150	3.108[a]	3.000	62.000	.033
	Roy's Largest Root	.150	3.108[a]	3.000	62.000	.033
CONDITI2	Pillai's Trace	.281	8.069[a]	3.000	62.000	.000
	Wilks' Lambda	.719	8.069[a]	3.000	62.000	.000
	Hotelling's Trace	.390	8.069[a]	3.000	62.000	.000
	Roy's Largest Root	.390	8.069[a]	3.000	62.000	.000
CONDITI1 * CONDITI2	Pillai's Trace	.068	1.511[a]	3.000	62.000	.221
	Wilks' Lambda	.932	1.511[a]	3.000	62.000	.221
	Hotelling's Trace	.073	1.511[a]	3.000	62.000	.221
	Roy's Largest Root	.073	1.511[a]	3.000	62.000	.221

a. Exact statistic

b. Design: Intercept+CONDITI1+CONDITI2+CONDITI1 * CONDITI2

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	PRIVACY	48.993[a]	3	16.331	8.943	.000
	SCREEN	16.717[b]	3	5.572	3.847	.014
	ATTITUDE	34.364[c]	3	11.455	5.483	.002
Intercept	PRIVACY	1024.941	1	1024.941	561.295	.000
	SCREEN	1603.412	1	1603.412	1106.868	.000
	ATTITUDE	1665.180	1	1665.180	797.059	.000
CONDITI1	PRIVACY	3.579	1	3.579	1.960	.166
	SCREEN	10.405	1	10.405	7.183	.009
	ATTITUDE	15.533	1	15.533	7.435	.008
CONDITI2	PRIVACY	39.765	1	39.765	21.777	.000
	SCREEN	4.659	1	4.659	3.216	.078
	ATTITUDE	18.533	1	18.533	8.871	.004
CONDITI1 * CONDITI2	PRIVACY	5.649	1	5.649	3.094	.083
	SCREEN	1.652	1	1.652	1.141	.290
	ATTITUDE	.298	1	.298	.143	.707
Error	PRIVACY	116.866	64	1.826		
	SCREEN	92.711	64	1.449		
	ATTITUDE	133.706	64	2.089		
Total	PRIVACY	1190.800	68			
	SCREEN	1712.840	68			
	ATTITUDE	1833.250	68			
Corrected Total	PRIVACY	165.859	67			
	SCREEN	109.428	67			
	ATTITUDE	168.070	67			

a. R Squared = .295 (Adjusted R Squared = .262)

b. R Squared = .153 (Adjusted R Squared = .113)

c. R Squared = .204 (Adjusted R Squared = .167)

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